30 NO-COST UPGRADES TWEAK WINDOWS + THE BEST FREE APPS & MORE

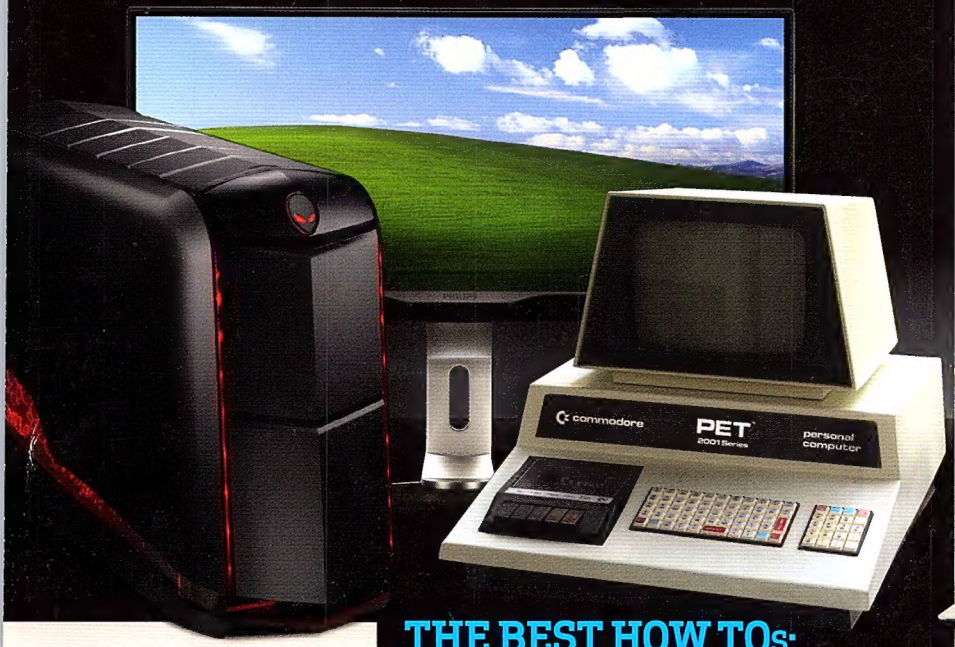
apc

March 2014
Issue 400

YOUR EXPERT GUIDE TO TODAY'S TECH

400TH ISSUE!

APC CELEBRATES WITH A RETROSPECTIVE LOOK BACK AT 30 YEARS OF THE PC



ULTIMATE UPGRADES

SPEED UP YOUR RIG!

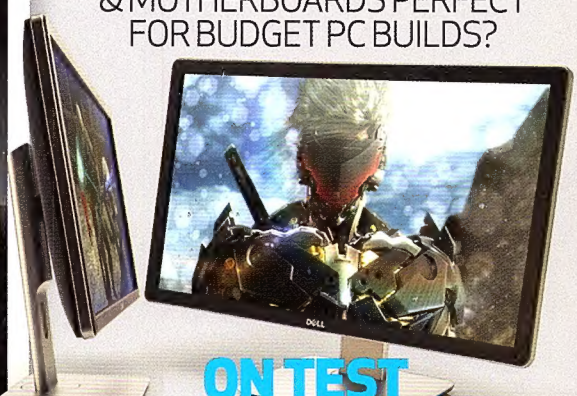
Our experts guide you through the upgrade maze to help you locate the best-value PC parts

DESKTOP PCs REVIEWED

What does $1,500 buy you now compared to 1980?

AMD STRIKES BACK

ARE THE RED GIANT'S NEW CPUs & MOTHERBOARDS PERFECT FOR BUDGET PC BUILDS?



ON TEST AFFORDABLE 4K MONITOR

Dell's 24-incher that packs 4x the res of your 1080p screen

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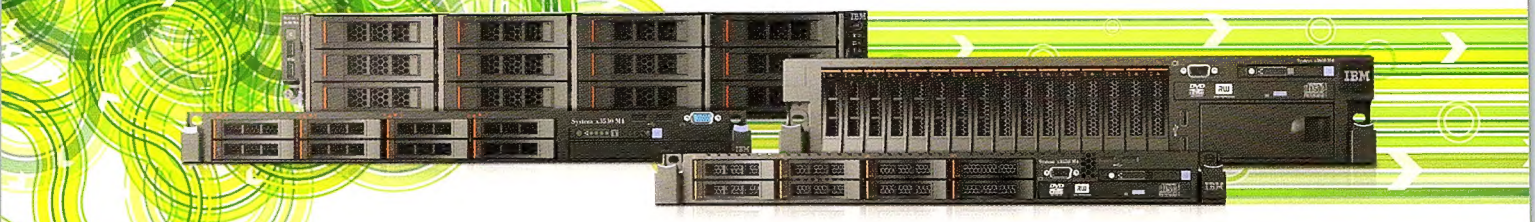

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1. As of December 3, 2013. See http://www.tpc.org/1791

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FIPP

Here's to 400!

APC's editor Dan Gardiner gets a little emotional in toasting Australia's oldest tech mag.

Welcome to this special 400th issue of *Australian Personal Computer* magazine. 400 issues – or 34 years – is a long time, especially when it comes to technology, so we hope you'll forgive us a little indulgence as we celebrate this milestone.

APC's first issue was published in May 1980. While it wasn't the first computer mag in the world, it did arrive on the scene very early and it is, quite possibly, the oldest general-interest computing magazine in the English language. (As far as my research can find, in English we're predated only by a couple of IT professional US mags – *ComputerWorld* and *InfoWorld* – and in the general-interest category, only by the German publication *CHIP*, which was launched two years earlier than *APC* in 1978.)

Flip back through the pages of *APC*s' past and you'll find a fairly succinct timeline of the history of the PC. From those early, (comparatively inexpensive) machines that came without software – and that hobbyists would therefore have to sit hunched over for hours, painstakingly entering line after line of code into – to the wirelessly connected pocket-sized PCs that are today's smartphones, it's safe to say that the computer has changed a lot since *APC*'s first issue.

But much more than that, the PC has also radically modified the world we live in – and continues to do so. Computers are the engines of change that have transformed the entire planet over the last 70 or 80 years, and the last 30 or 40 in particular. *APC*, then, isn't just a mag about the computer, but one that, in a roundabout way, is also about this gradual technological revolution that we've all been – and still are – living through.

As an editor, I've generally found that planning a monthly magazine like *APC* is a bit like preparing a huge banquet. It's about selecting the finest in-season produce, preparing a menu and then, instructions in hand, sending your various specialist 'chefs' off to go and produce their dishes. Like any creative endeavour, there's more than a little voodoo magic – and luck – involved in getting the recipe right. And knowing what your guests enjoy and expect from you plays a big part too.

APC has always straddled a line between providing tech information for general consumers, enthusiasts (aka 'hobbyists') and essential knowledge for IT pros. We're a broad church that welcomes any type of reader – so long as they share a love of computers and technology. And really, it's you, the readers of *APC*, who we've really got to say thanks to. It's no great secret to say that without your loyal support, we wouldn't have been able to reach this mammoth milestone.

So, in the party spirit can we all raise a glass to the personal computer – in all its guises. May it continue its long history of transformation – and of changing us, as well – as it's done so for the first 400 issues of *APC*. As always, we'll be watching with keen interest.

DAN GARDINER
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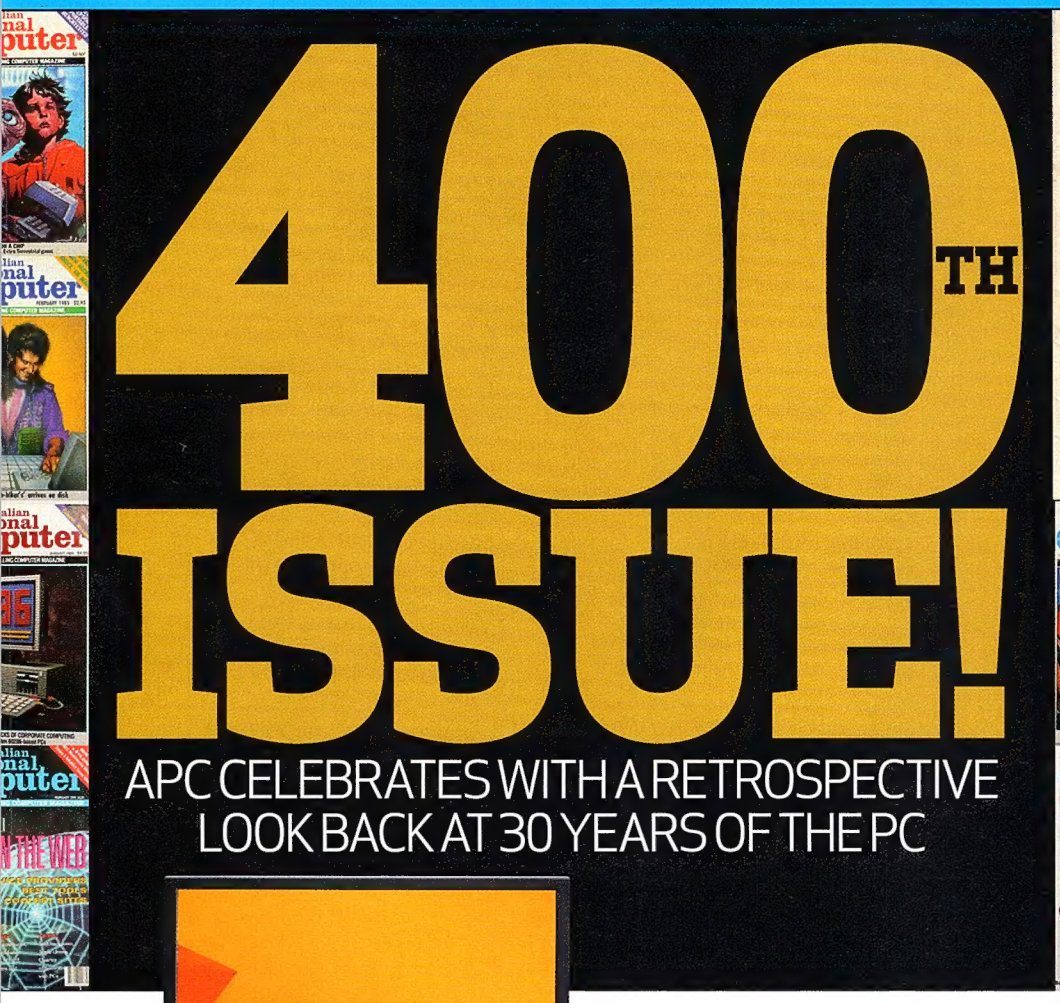
Contents

Issue 400 March 2014


400TH ISSUE!
APC CELEBRATES WITH A RETROSPECTIVE LOOK BACK AT 30 YEARS OF THE PC
AUSTRALIAN Personal Computer
GUIDE TO BUSINESS SOFTWARE
ARTIFICIAL INTELLIGENCE WITHOUT TEARS
David Levy series on game theory
Australian Personal Computer
Red Hot 486s
DX2/66

50 UPGRADES THAT WON'T BREAK THE BANK

SEE WHAT WINDOWS CAN REALLY DO WHEN IT'S TREATED TO SOME ATTENTION! WE REVEAL 50 OF THE BEST TWEAKS AND APPS TO UPGRADE YOUR OS. PAGE 68.

» features

40 400TH ISSUE AND COUNTING
We take a look back at the last three-and-a-bit decades of APC.

50 THE PCs OF APC
From the Commodore 64 to 64-bit computing, we examine at the glorious history that is personal computer hardware.

55 ULTIMATE UPGRADES
We guide you through the upgrade maze to help you find the best new parts for your PC.

68 50 UPGRADES THAT WON'T BREAK THE BANK
The best tweaks and apps to upgrade your operating system.

78 WILL YOUR NEXT MAC RUN ON AN APPLE A7 CHIP?
Will Apple really replace Intel?

» technotes

6 NEWS
The latest developments in the tech world.

10 GADGETS
Hot tech gear we want to own.

12 NVIDIA G-SYNC
Nvidia's latest tech is all about silky-smooth framerates.

14 VOLUMETRIC DISPLAYS
3D displays of the future.

16 EPINIONS
See what APC's readers have to say.

17 END USER
Not everyone is computer literate.

"Kerry Packer shook his head and said 'Good God son, compared to you Ned Kelly was a princess!'" Brave beginings, P42

29 BENQ 27-INCH DISPLAY

28 DELL 4K SCREEN

26 GIGABYTE RADEON R9 290X

20 AMD'S NEW APU

31 LATEST CASES

24 OCZ VERTEX SSD

22 ASUS A88X-PRO

» the lab

20 LATEST REVIEWS

20 AMD A10-7850K
22 ASUS A88X-Pro
23 ASRock FM2A88X-ITX+
24 OCZ Vertex 460 240GB
26 Gigabyte GV-N78TGHZ-3GD
26 Gigabyte GV-R929XOC-4GD
27 Wacom Intuos Pro
28 Dell UltraSharp UP2414Q
29 BenQ BL2710PT
30 Viewsonic VP2770-LED
31 Corsair Obsidian 250D
31 Lian-Li PC-Q30

34 SOFTWARE REVIEWS

» how to

82 QUICK TIPS
We fix readers' computing problems.

84 TUTORIALS
84 Automate Windows the clever way
88 Remote music streaming with Linux
90 Tags 102
92 Mastering Pages for iPhone
95 Create user defined functions in Excel
96 Ultimate Tasker guide — part 3: Using data from the web

98 MASTERCLASSES
98 PC builder: Create a SteamOS box
102 Arduino: Stereo Peak Program Meter
106 Android Xposed

» downtime

110 GAMES
High-performance playtime.

114 CHIP CHAT
News from the world of geekdom.

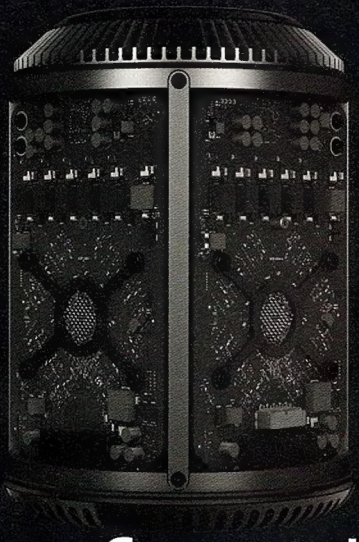
» on the disc

- » Ashampoo Burning Studio 2014
- » 1-abc.net Hard Drive Washer 7
- » Abelssoft Folder Visualizer 6
- » X-Motor Racing: playable demo
- » Word processing essentials tool kit

Find your disc inside on page 67.

technotes

» NEED TO KNOW BY PETER DOCKRILL



Almost a year to get to Australia? Is it coming by ship?

Mac Pro: futurish in more ways than one

Supply problems have taken the shine off this futuristic wastepaper basket.

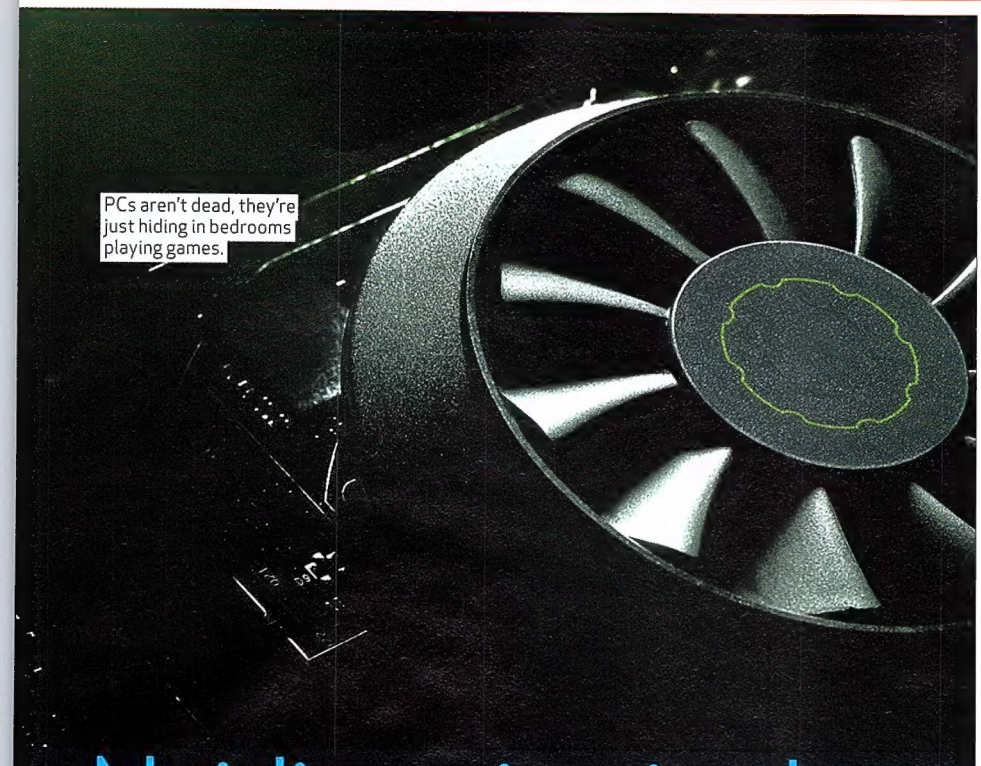
When Apple unveiled its tubular update to the long-neglected Mac Pro last year, it's fair to say the entire PC industry undertook a collective double-take. With more than a passing resemblance to the black monolith from *2001: A Space Odyssey* – or, somewhat less flatteringly, a wastepaper bin – the shiny, black metal cylinder recalibrated our notions of what a desktop PC could look like. But despite wowing the punters (and impressing some early reviewers), the launch of the celebrated new "Made in the USA" Mac Pro hasn't been without some teething issues, most notably concerning shipping timeframes. Despite going on sale in December 2013, international shipping dates have been pushed back more than once, with the Australian Apple Store at time of writing indicating orders won't be delivered until sometime in April. For a machine initially previewed in the middle of 2013, not reaching most customers until nearly a year later indicates some significant supply hurdles. Apple's commitment to solely manufacturing the machine in its Texas facility might have scored it patriotic points back home, but at what cost?

iPhone zealot queues up seven months early

Nobody likes missing out on the latest gadgets... but this one takes the cake. A Japanese man *dressed as a giant iPhone* took it upon himself to queue up outside an Apple Store in Tokyo to await the release of the iPhone 6. The only thing is: the iPhone 6 hasn't even been announced yet. Its existence at this point, though extraordinary likely, is still completely speculative, with conservative estimates putting its release at several months away. Upon being informed of this overwhelmingly obvious fact by Apple's retail reps, the mysterious iPhone man — who's said to be a Japanese tech blogger — packed up his things and walked away, with his iPhone-shaped head looking decidedly downcast. Publicity stunt? Who can tell? The one thing we're sure of: this strange man was not sold an iPhone 6.

Chrome OS making bid to run Windows apps

With every passing month the steady support growing behind Chrome OS helps elevate Google's streamlined operating system from mere 'intriguing curiosity' status to a wild card increasingly threatening Windows and OS X on the desktop. Budget-priced Chromebooks are growing in popularity, now commonly seen alongside Windows and Mac models in retailers like JB Hi-Fi, and the low-cost, lightweight PCs have certainly been a hit in the US, where they accounted for more than one in five commercial laptops sold last year. Up until now, the major drawback with Chromebooks has been that they won't run any of the traditional Windows software that buyers are familiar with, but soon it looks like users might not even have to make that compromise. Google and VMWare have announced they're joining forces to make Windows apps available on Chromebooks via VMWare Horizon View. At present VMWare's DaaS (Desktop as a Service) product is primarily aimed at business customers and corporate fleets, but if the virtualisation solution takes off we suspect it won't be too long before we see a consumer version...



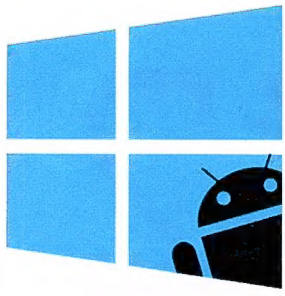
PCs aren't dead, they're just hiding in bedrooms playing games.

Nvidia gains in the face of PC decline

Don't believe everything you read. PCs aren't dead in the water.

There's a lot of talk in the media, including these very pages, about the so-called 'death' of the PC industry. The argument goes that, with the rise of the tablet and the smartphone – two distinct but highly relative technologies – users are allocating less time, money and attention to their PCs. And, to a certain extent, it's true. But, looking a little more broadly, practically all consumer tech is in a state of flux right now, and the 'death of the PC' cliché is sometimes a little overplayed. One good counterpoint is GPU maker Nvidia, which recently reported robust growth for the final quarter of 2014, with revenue of US$1.14 billion (up 8.6% on the previous quarter). According to Jen-Hsun Huang, president and CEO: "Quarterly revenue came in well above our outlook, driven by PC gaming, capping an outstanding year for our GPU business." The fact that a company, whose largest revenue generator is PC gaming, is right now experiencing solid growth – and this in the very same period that saw the launch of the AMD-powered Xbox One and PlayStation 4, mind you – just goes to show that there's more than one side to this story.

Things are starting to look up for induction charging pads. Industry groups are working together to standardise the technology.



Windows to run Android apps... say what?

You scratch my back, I'll scratch yours: not only is Google implementing plans to bolster its small-but-growing Chrome OS by enabling virtualised Windows apps to run via VMWare (see left), but Microsoft is said to be considering returning the favour. Sources have told *The Verge* that, due to the difficulty Microsoft is experiencing in populating its tumbleweed-esque app stores for Windows 8 and Windows Phone 8 – the company is seriously considering enabling a system to allow Android apps to run on its own platforms. But would such a play prove to be a bold defensive initiative... or a last-ditch suicidal endeavour? Attentive *APC* readers may remember that, not all that long ago, a struggling BlackBerry tried to pull off the same customer-luring manoeuvre... to rather limited effect. Of course, with Windows 8 already experiencing an uncomfortable 'house divided' dichotomy – straddling its two distinct Metro/Desktop halves – the last thing it needs is a third pillar further complicating things, surely?

Wireless alliance ties things up

Effortless and convenient: that's what we've been told to expect from the wireless charging revolution, but it's turned out to be a bit of a damp squib so far. While there's a smattering of nifty induction pads available for smartphones and tablets, opposing industry standards have retarded a singular development of the tech, meaning most people still opt for cables to provide the requisite juice for their devices. But things might be about to change, with two of the three industry groups involved – the Alliance for Wireless Power (A4WP) and the Power Matters Alliance (PMA) – signing an agreement indicating their standards will now work together. It's hoped the move will entice more device manufacturers to get behind the technology, although until we see some truly standout products or functionality – like a major feature push from somebody like Apple or Google, for example – we wouldn't be surprised if wireless remains the exception rather the norm in the short term.

$2.91 BILLION

In 2011 Google bought Motorola for US$12 billion. Three years later it's selling the company to Lenovo for under US$3 billion.

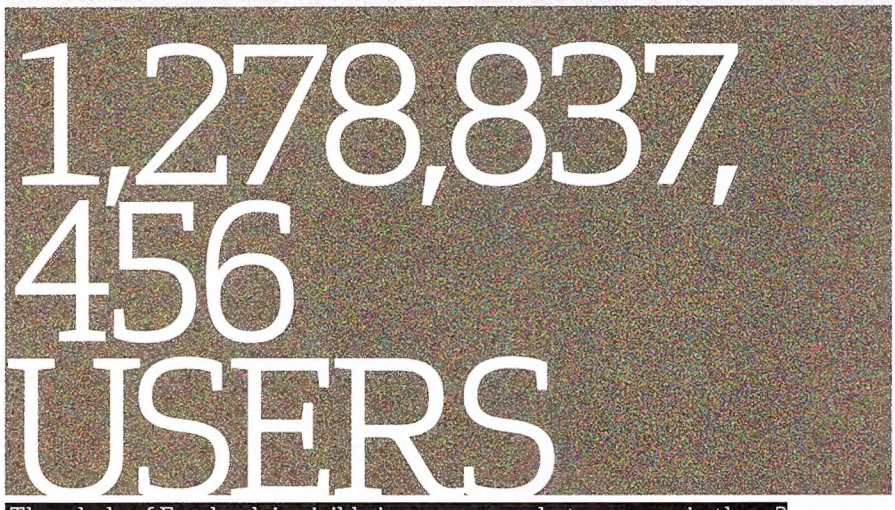
Big companies seem to buy smaller companies the way you might buy a new pair of pants: once or twice a year, after more than a little self-examination on whether you really need another pair of tan chinos. OK, so maybe there's no similarity (I tried), but it's worth noting that Google is taking a massive loss (to the tune of 9 billion dollars) on its sale of Motorola to Lenovo — although it does get to keep those juicy mobile patents. Long-standing *APC* readers might remember when Lenovo adopted IBM's consumer PC business some years back... Will it enjoy the same success in the mobile market? Let's watch and see.

1 BILLION

Smartphones shipped in 2013 top one billion devices.

In a groundbreaking demonstration of users' lust for smartphones, market watchers IDC have confirmed that more than a billion of the handsets were shipped last year. All in all, some 1,010.4 million smartphones were shipped internationally in 2013, a 38.4% increase on 2012's volume. Samsung was the biggest winner of the vendors in play, although moving ahead the Korean heavyweight's Android empire is expected to face increasing pressure from Chinese brands selling budget models.

1,278,837,456 FACES
OF FACEBOOK TOGETHER



The whole of Facebook is visible in one screenshot... are you in there?

What do a billion users look like? The answer is pixellated, colourful and not altogether unlike old-school analogue TV static. 'The Faces of Facebook' is a rather mind-blowing web project that combines the profile photos of Facebook's nearly 1.3 billion users in a single, interactive macro image. You can zoom in to micro level too and find yourself and your buddies (and their joining numbers, interestingly). Check it out at **www.thefacesoffacebook.com**.

$1 MIL

Prince sues 22 fans for US $1 million apiece.

Pop impresario Prince is infamous for zealously defending his intellectual property, a propensity at odds with these digital times — where users' ability to share content (rightly or wrongly) is only ever a click of a button away. His Royal Purpleness made the headlines recently when he sued 22 fans for posting links online to bootleg recordings of his concerts. After the legal pressure, the fans removed the links and Prince promptly dropped the lawsuit, leading trashy entertainment site TMZ to dub him — rather amusingly — "The Artist Formerly Known as Plaintiff". Tee hee.

0%

An analysis of US smartphone activations reveals BlackBerry may have sunk to zero market share.

Call it the ambiguity of rounding — the imprecision of margins of error when sales data is so close to negligible — but at least one survey of the US smartphone market has concluded that BlackBerry's flagging market share equates to... no share whatsoever. In Consumer Intelligence Research Partners' assessment of mobile activations in the fourth quarter of 2013, the analysts pegged iOS at 48% and Android at 46%, with Windows Phone and non-smartphone mobiles tied at 3% each. Add it all up, and that leaves exactly 0% left for the ill-fated BlackBerry, which launched its BlackBerry 10 OS amid much fanfare only one year ago.

STORMING THE COMPETITION

WELCOME THE GEFORCE GTX 750 TI STORMX DUAL

Not everyone is capable of shelling out a ton of money to get a beefy enthusiast card, which is why the green team has just released the extremely power-efficient, Maxwell-based GeForce GTX 750 Ti. Coupled with this release is Palit's own custom-cooled and beefed up GeForce GTX 750 Ti StormX Dual.

The Brewing Storm

Palit is making its latest stand for customized graphics cards. The company is releasing a card based on the new GeForce GTX 750 Ti with tons of customizations.

Utilizing NVIDIA's Maxwell architecture, the GeForce GTX 750 Ti is capable of providing better performance without the need for more power. It doesn't require any extra power connectors, so you can upgrade your desktop PC without buying a new power supply.

The Maxwell-based card is cooled by the StormX Dual cooler. This reliable cooler features two 80mm fans that have the TurboFan Blade design for increased airflow while maintaining low operation noise.

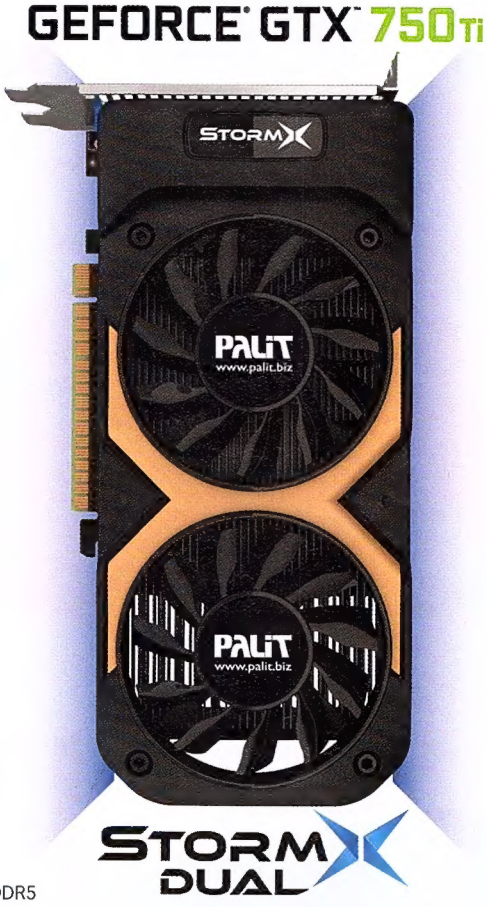
Palit doesn't stop there, as the StormX Dual comes equipped with solid capacitors, ferrite core chokes, and an improved PWM design. Utilizing these, the card is able to run more efficiently and get an increase in its overclocking potential. With these changes, the card sports all-time high clock speeds of 1202MHz for the core and 6008MHz for the memory.

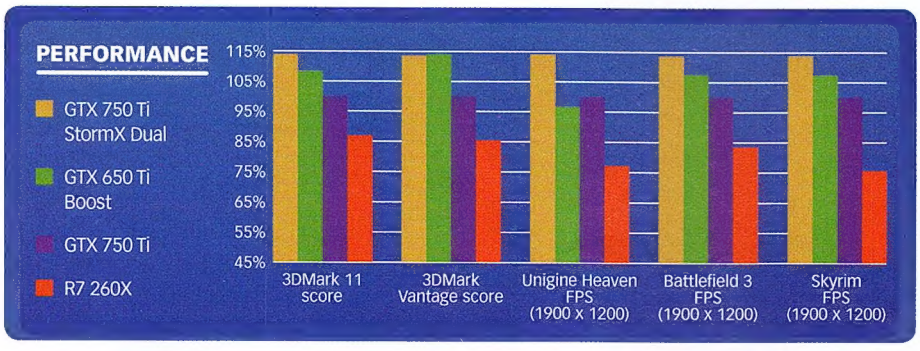
As with all GeForce cards, this card also features NVIDIA technologies such as PhysX, GPU Boost 2.0, Adaptive Vsync, and ShadowPlay, to name a few.

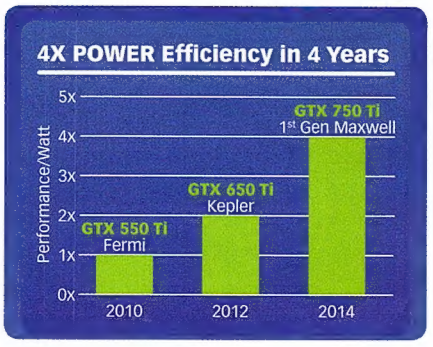
Without a doubt, this card makes for a perfect partner for gamers on a budget.

Key Specifications:

• CUDA Cores:	640
• Base Clock:	1202MHz
• Boost Clock:	1281MHz
• Memory Config:	2GB/128-bit GDDR5







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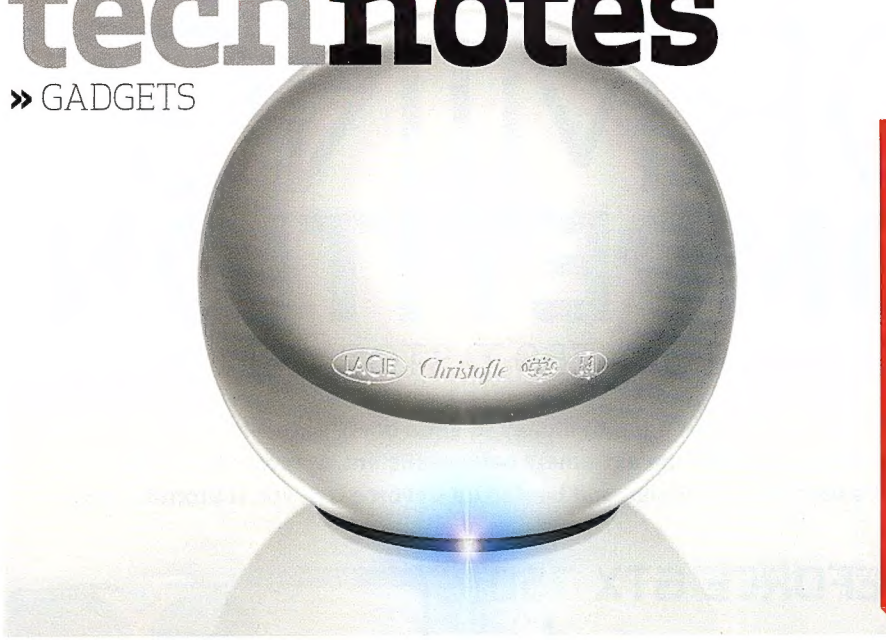

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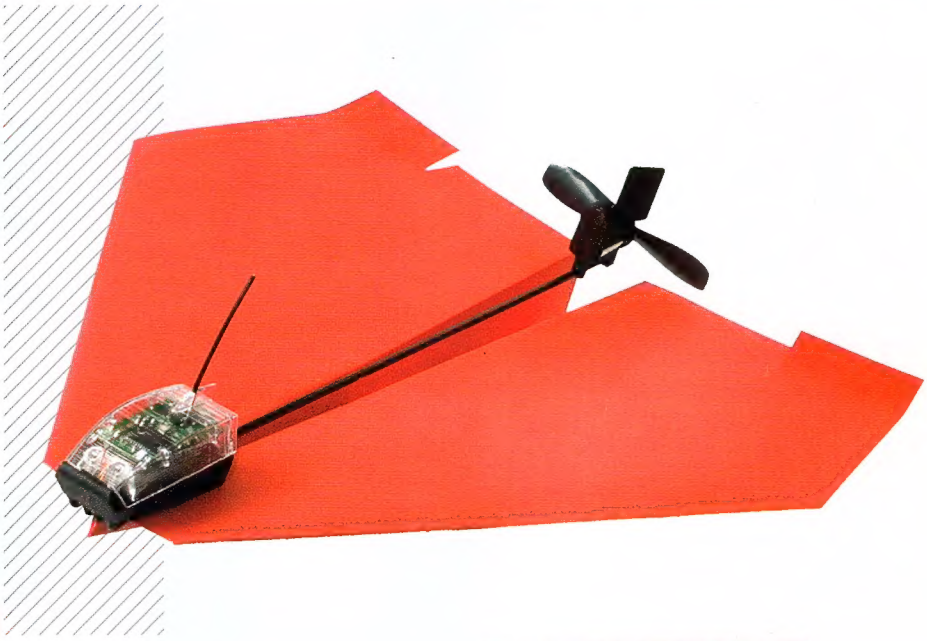
Lacie's Sphère comes from the school of thought that if you're going to put an external hard drive on your desk, it might as well be something that looks good too. And we will admit that the Sphère looks pretty stunning. Developed in cooperation with the silversmiths at Christofle, the Sphère is a fully functional, USB-connected 1TB external drive that's hand-crafted and plated in silver. It looks like a work of art... and it's priced to match!

POWERUP 3.0 SMARTPHONE CONTROLLED PAPER AIRPLANE

US$49.99 PLUS ~US$25 SHIPPING | WWW.POWERUPTOYS.COM

Even when expertly fashioned by a master office craftsman, paper airplanes have virtually no staying power. Enter PowerUp, which — with its successfully Kickstarted 3.0 incarnation — adds an engine, rudder, and remote-control iPhone app meant to turn your creations from a product of boredom into a legit flying toy. And when your paper plane inevitably crumples on impact, you can just make another one...



ASUS CHROMEBOX

US$179 | WWW.ASUS.COM/AU

Got a spare $179? OK, so that's the quoted US price, meaning we'll inevitably pay a chunk more when we see the ASUS Chromebox land on Aussie shores, but this diminutive PC is further proof that we're in the midst of a computing revolution. While Microsoft's Windows held a comfortable monopoly on the desktop OS front for the last two decades, we're now seeing an explosion in alternative systems, chiefly budget models based on Google's Chrome or Android OSs. No Windows licensing fees means it's cheaper for everybody, and this ASUS model isn't even as underpowered as you might fear, with 4th-gen Intel Celeron processors supposedly letting the tiny dynamo run 4K content. Could be a nice solution for a living room PC, no?

IRIDIUM GO

TBA | WWW.IRIDIUM.COM

Many many moons ago, before all her Oscar-winning glory – not to mention a high-profile marriage to scientologist extraordinaire Tom Cruise – Nicole Kidman starred in a taut Aussie thriller called *Dead Calm*, in which she and Sam Neill were terrorised on a boat by a maniacal, murderous Billy Zane. The trouble was it was just the two of them against him, as, being stranded on a yacht in the middle of the ocean, with no radio or comms, they weren't able to contact anybody and scream, "Help! Send help! Billy Zane is trying to kill us!" Things might have gone a little differently for the pair if they'd had an Iridium GO: the world's first truly global satellite hotspot, which lets you connect up to five devices via Wi-Fi to get mobile and web access no matter where you are.

TWELVE SOUTH BOOKBOOK TRAVEL JOURNAL

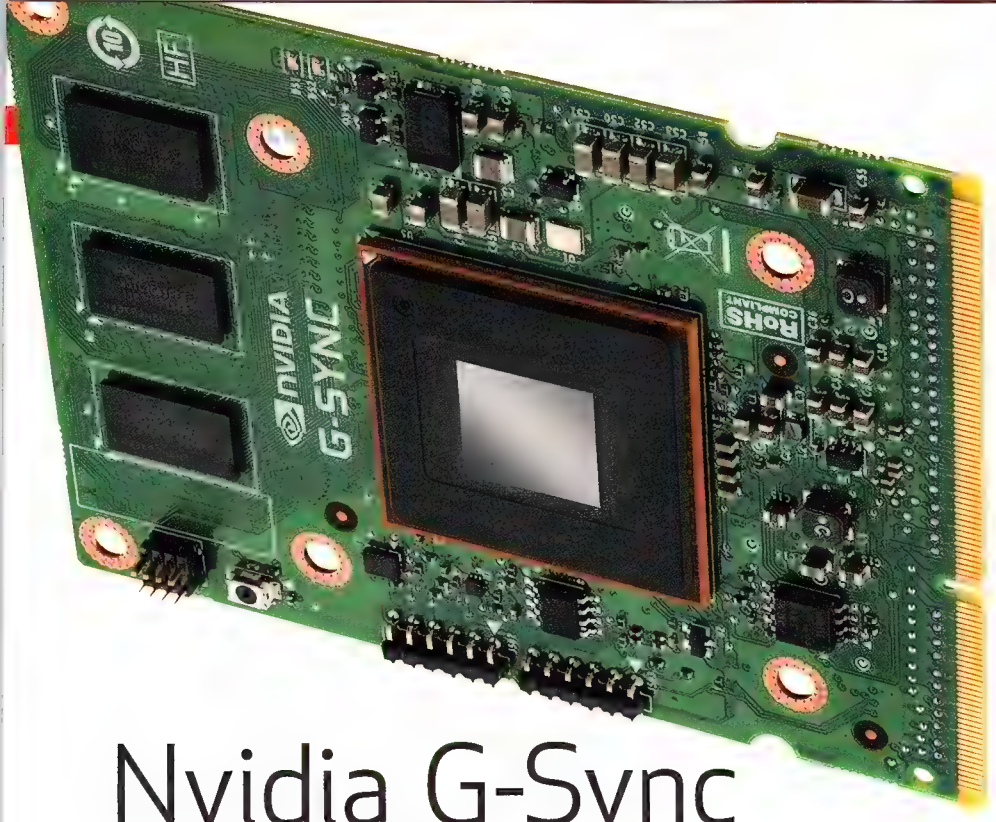
$110 | TWELVESOUTH.COM

We love Twelve South's BookBook range of iOS cases, which are designed to make your iPad or iPhone look like an old leather-bound tome. The Travel Journal is a thicker variation on the iPad BookBook, and holds various accessories as well as your iOS tablet. It's every bit as gorgeous and well made as other BookBook products, with a real leather exterior and sturdy zips, but it's a little more restrictive than we'd like. It's not quite big enough to hold an iPad with a keyboard cover fitted, for example, though you can fit a pair of compact over-ear headphones in the other side.

ELGATO SMART KEY

$70 | ELGATO.COM

The Smart Key is a little Bluetooth tag that can protect anything it can be stored in or fastened to. Using the free app, pair it with your iOS device, and if they become separated (ie. out of Bluetooth range) you get an alert on your phone, and a map showing where the connection was lost. Unfortunately, there's no way of setting a custom distance to (for example) keep your keys within six feet of you, but allow 15 feet for your suitcase in a train's luggage rack. You can however use the app to make the Smart Key bleep, and vice versa in case you lose your phone.



Nvidia G-Sync

Phil Iwaniuk discovers that Nvidia's latest technology is more about silky-smooth framerates than tepid '90s boy bands.

Getting a high frame rate is only half the battle. As difficult as that is to read after you've just dropped a small country's GDP on the latest, most aggressive-looking graphics card, raw GPU processing power alone won't give you the smooth-as-butter experience you dream of in your most private moments (no, not the one with Miley Cyrus and the baby oil). Your rig can produce all the frames it likes, but unless they're being delivered in perfect synchronisation with your monitor's refresh rate, you're going to experience artefacts like screen tearing or stuttering. And under current technological constraints, there isn't a damn thing your graphics card can do about it.

That's why the boys and girls in green have been fiddling around with monitors to come up with a solution. The fruit of Nvidia's labour is G-Sync, a bit of in-panel circuitry that aims to eradicate the current catch-22 situation associated with vertical sync (Vsync). To understand why that's any kind of big deal, we need to get to grips with the problem in the first place.

TATTERED & TORN

So then, the Vsync catch-22: turn it off and you're gonna suffer screen tearing. Turn it on and you're in for a stuttering ride unless your rig can guarantee that it will run at a constant 60fps to match your monitor's 60Hz.

Tearing occurs when your monitor and graphics card are polling at a different rate – if your monitor is running at 60Hz and your GPU is putting out 100 frames per second, for example. Your screen is updating itself 60 times a second, and each time it does, the graphics card has more than one complete frame in its buffer, which it uses to partially update the image. The next time the monitor refreshes, your GPU uses the extra frames again to overwrite the previous partial frames, and so on.

Because its fps production rate is disjointed with the monitor's refresh rate, the image eventually becomes disjointed because it's created by partially rendered frames that move on before finishing a full image. Picture the old slapstick skit where the man tries to keep on top of an ever-accelerating conveyor belt and you've got the idea.

What Vsync does is lay down some rules for your GPU's frame buffer. Specifically, it ensures that no frames are moved from the back buffer(s) to the frame buffer until just after the monitor refreshes itself. No partially rendered frames, no unfinished images, no tearing. Simple.

Except, of course, it isn't. Under Vsync's rule, if your graphics card can't keep up with the monitor's refresh rate, it gets into different kinds of trouble. Let's say this time your monitor is still refreshing at 60Hz, but your GPU only has the grunt to render 50fps. In this scenario, every time the graphics card completes a frame in its back buffer it has to wait for the screen to refresh, so it falls further and further behind. In the days of double buffers, that meant if a GPU couldn't match the monitor refresh rate it was forced to swoop down to half of it to remain in sync. Triple buffers alleviate that phenomenon to an extent, but the fact remains that during scenes likely to cause major FPS fluctuation, you'll notice an even greater level of stuttering because Vsync won't let your GPU deliver frames in its own time.

That's the trade-off with current monitor technology – brave the tearing, or suffer the stuttering. But G-Sync doesn't want you to have to make that call, damn it. What it does is turn the whole process around on itself, so rather than relying on the monitor to decide when an image is refreshed, it puts all the control in the GPU's capable hands. With a few considerable provisos and limitations.

"It's irresistibly smooth. It gives an almost intangible flow to any 3D-rendered sequence"

Firstly, G-Sync only works with Nvidia GTX 650 Ti cards or better. If you're an AMD owner, you're out of luck. The best Team Red can manage is a free version for laptop screens (see 'AMD's syncing feeling'). Secondly, the logic board is designed to be installed into your monitor, rather than your graphics card. Currently, if you want to get G-Sync working on your system you'll need to do one of the following unappealing options: find and buy the Scan-modified ASUS VG248QE for some US$480, buy the logic board kit and install it in a VG248QE yourself, or wait until later this year when the first wave of G-Sync-capable screens flood the market.

SMOOTHLY DOES IT

It seems like a bit of a faff until you see G-Sync in action. Racing games are turned into the liquid-smooth arcade dreams of yesteryear, RTS titles are transformed from juddering messes to silky scrolling sequences that appear pre-rendered. The bottom line here is that when you see G-Sync running for the first time, you'll want it running every time you boot up your machine. It effectively ruins PC gaming by highlighting the tearing and stuttering you've been putting up with all this time.

It's irresistibly smooth. Not only because it eliminates the above artefacts so effectively, but also because it gives an almost intangible flow to any 3D-rendered sequence that you can't achieve otherwise. Even 3D menu navigation looks amazing.

The counterpoint to G-Sync's present, fussy hardware requirements and pricing premium on 1080p monitors is that once you have the necessary kit, there's not much hassle involved to get it working. Nvidia has already released drivers that patch in its functionality, and once they're installed, you need only fiddle with a couple of options on the Nvidia control panel.

The first port of call is to make sure your monitor is set to its maximum refresh rate, and its resolution is set at 1080p (higher resolution support is on the way later in 2014, Nvidia says). Then pop over to the 'Manage 3D Settings' option and set the Vsync setting to G-Sync. *Et voilà* — smoother gaming than you dared dream about.

There are obvious concerns with this tech — while one side of the monitor market pushes towards ever-increasing native resolutions and a near future in which 4K is the standard, Nvidia — in the short term at least — is pulling in the other direction by fitting its latest tech in a 1080p screen that costs as much as most 1440p models. Keep your eyes open over the coming months and years as prices of both G-Sync logic boards and high-res screens drop, instead of rushing out and becoming an early adopter. When 1440p screens and higher are fitted with G-Sync as standard, PC gaming will take a big leap forward. Right now, Nvidia's just letting us know that it's squatting in preparation for that jump. ■

AMD's syncing feeling

Could AMD's FreeSync leave Nvidia's G-Sync quivering in its boots?

Nvidia's GPU rival tends to compete for the same market share by taking a totally different approach, so you'll hardly be surprised to learn that AMD's equivalent of G-Sync, which it's calling FreeSync, doesn't require any financial outlay — hence the name. Nor does it involve modding your panel's circuitry. It's an aggressive marketing stance for AMD to take (the rhyme is surely no accident), and it aims to pull the rug out from under Nvidia's feet by removing money from the equation.

Ready for the caveats? FreeSync only works with panels that support a variable VBLANK (a refresh command that can be issued at non-regular intervals), and right now that limits it almost exclusively to laptop and tablet screens. A variable VBLANK is pretty useful for devices running on batteries, because it means they don't have to waste power refreshing the screen when there's no new content that it needs to be updated with. Your existing PC monitor almost certainly does not support it.

As for graphics hardware itself, AMD's Kaveri and Kabini APUs both support FreeSync, as does the newest wave of GPU circuitry to hit the market. Like Nvidia, AMD already has driver support for its tech; it's hardware compatibility that's holding it back from entering the mainstream and becoming the new viewing standard.

So it isn't yet the money-saving alternative to G-Sync that AMD wants it to be, but FreeSync's existence sets industry momentum moving in the correct direction. When standalone, laptop and tablet screens are all fitted with one or the other as standard, and every APU and graphics card out there can run the command, then we're talking — and competition between the two will drive the rate of progress towards that scenario at a faster rate. We can't wait to see what happens.

True 3D images are still some way off, but the technology is improving all the time.

Volumetric displays

The 3D displays of the future should be more like science fiction than the Victorian illusions we're still struggling on with today. Alan Dexter checks out the technology.

Stereoscopic 3D displays, invented in the Victorian era, have recently come back into vogue. Cinemas have been kitted out with the latest tech needed to display movies in the format, and the consumer electronics industry has worked itself up into a lather as it tries to make 3D TVs the latest must-have technology. The latter plan hasn't had much success at all, while the '3D' experience in many cinemas has left viewers wanting more. The question is, how long will it be before we get 'real' 3D displays like those seen in *Star Wars* and *Prometheus*?

Although many of us would describe such effects as holograms, a more technically accurate description of them would be 'volumetric displays'. That is, a 3D representation of an object (or objects) in a true 3D space, not simply on a 2D plane. Two-dimensional holograms, even moving ones, aren't generally considered to be volumetric displays, despite them showing different images as you change your position and viewing angle, because the hologram itself isn't actually 3D.

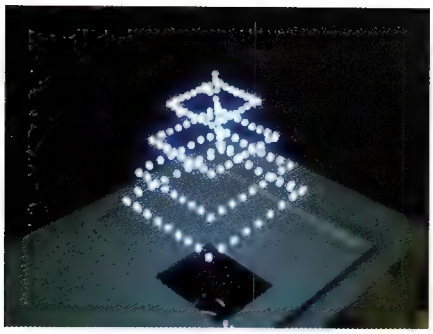
This definition of volumetric displays also precludes the need for any glasses.

SCI-FI TO REALITY

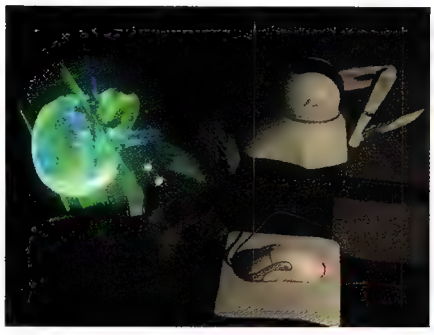
It may surprise you to learn that volumetric displays do already exist. There aren't many of them around, and they are for the most part crude implementations, but as a proof of concept they are interesting.

There are two distinct methods for producing such displays: swept and static. Swept-volume displays create the impression of a 3D object by building it up in layers. A crude example of such a display can be made up from multiple LEDs placed on several vertically separated arms that turn on and off at specific intervals to produce a 3D image that you can walk around and look at from various angles.

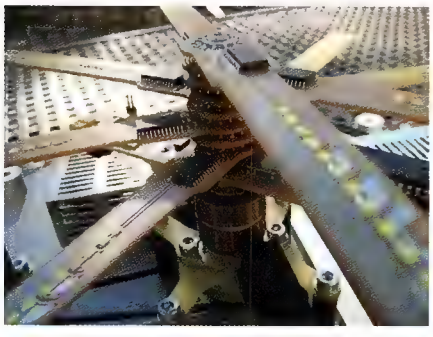
> "Two-dimensional holograms, even moving ones, aren't generally considered to be volumetric displays."



This static volumetric display can produce glowing points in a 3D space above the apparatus, although only in white.



Actuality Systems' volumetric display Perspecta, showing an image of an oncology radiation treatment plan.



Swept-volume displays such as Max Mali's viSio, seen here, build the 3D image out of several layered images.

As the name suggests, static volumetric displays don't have any moving parts in the display space. Such systems require a volume of elements that are transparent in their 'off' state, but visible in their 'on' state. Examples of such technologies use laser light to encourage visible radiation in the display material.

This display material could potentially be the air. A 2006 demonstration by Japan's National Institute of Advanced Industrial Science and Technology used a pulsed infrared laser to focus on a point in the air, which breaks down into glowing plasma. These glowing 'dots' could be projected in a cubic metre of air, up to three metres away from the apparatus.We're getting closer to true 3D all the time, but there's still some way to go. ■

Adding depth to 2D

The tricks that will keep the 3D dream alive while we wait for true 3D displays.

There are numerous ways of experiencing stereoscopic or 'pseudo-3D' images, movies and games while we await the arrival of true 3D displays. These techniques present slightly offset images to the left and right eye, images which the brain then interprets as 3D.

Polarisation

Here, two images are superimposed onto the same screen using polarising filters, and viewers wear glasses to decode the picture so that each eye sees a slightly different image. Polarised 3D systems are used in cinemas, but the filtering reduces light levels, and the '3D' image is half the resolution of a 2D image on the same screen.

Active shutter

This system uses a pair of liquid crystal shutter glasses to present one image to the left eye while blocking the right, then a different image to the right eye while blocking the left. The process is repeated so fast that the viewer sees a smooth '3D' movie, but the technology is expensive and flicker can be a problem.

Head-mounted displays

Although one of the oldest ideas in the field, head-mounted displays are making a comeback thanks to virtual reality gaming projects such as the Oculus Rift. The combination of separate images for each eye and integrated head-tracking allows for some clever tricks to do with immersion.

Anaglyph

Anaglyph is the cheapest form of stereoscopic imagery. It requires only a pair of paper glasses with red and cyan filters to view the encoded images, which are rendered with two different filters — one for each eye. There are problems, though, with the accurate representation of colour.

Interference filtering

This system uses specific red, green and blue wavelengths for the left eye, and different wavelengths for the right. Glasses then enable the viewer to see a full-colour 3D image. 3D images produced this way are better than anaglyph, but the filters for the glasses are more expensive and not considered disposable.

Autostereoscopy

Autostereoscopic displays don't require glasses. They present different images to each eye either by using a parallax barrier, or by having a lenticular screen over the image. The downside is that the viewer has to be a set distance from the image. This is the technique used by the Nintendo 3DS games console.

Pepper's Ghost

Rather than a system for displaying 3D images, Pepper's Ghost is a simple illusion created using glass and lighting. Dating back to the 17th Century, it was notably used in a 2012 music festival appearance by Dr Dre and Snoop Dogg, who used it to project an image of deceased rapper Tupac Shakur performing two songs.

SIMPLES!

I got the best idea the other day — how Windows 9 should be organised. I was thinking of all of Windows 8's "flaws" with the Modern UI and the fact that it works AMAZING for a tablet, but is a bit unwieldy for PC. Because Windows 8 is far faster than Windows 7, this is my opinion on what Microsoft should do with Windows 9: Have Windows detect when you have either a PC or tablet, then adjust the UI accordingly. Simple!
Jean-Luc Mackail

WHAT I WANT

Here are some changes I would like in Windows 9. In a nutshell I want only one Desktop or Modern UI. To accomplish this the Modern UI needs to be changed to contain a Taskbar (as in XP) to be able to quickly select applications that are loaded and quickly switch between applications. This Taskbar also needs to contain application icons so that I can quickly load applications or switch between applications.

Next the Start button needs to display a dropdown list of groups of Tiles, so that I can select my default group to only display the group of tiles that I regularly use — I would use this to run single applications where I would not be switching between applications — but still have this facility via the Taskbar.

"I was thinking of all of Windows 8's "flaws" with the Modern UI and the fact that it works AMAZING for a tablet, but is a bit unwieldy for PC."

Since there would not be a desktop I would expect to return to the Modern UI when an application exits, or to the next running application as happens with the XP Desktop.

In the File Explorer when I customise a folder I expect that only this folder is changed — not all folders. Also in File Explorer when I select a Favourite I expect this folder to be opened and display all files as in XP.

On the Taskbar I would like to add icons that display a menu of applications (as with Control Panel by right-clicking on this icon). All of these options I want to be easily customisable.

I want for my main screen all the facilities of the XP desktop plus the facility to add menu selectable items to the Taskbar, plus the facility to only display the Group of tiles that I have selected (other groups of Tiles could be selected).
Spencer Smith ■

ROLL BACK

I refer to a possible fix Matthew Bolton mentioned in the Christmas edition of APC. It didn't work for me and I wasn't able to find any useful links. I have tried numerous things on getting my iPhone 4 back to iOS 6 instead of iOS 7 that I am now running. Many blogs on the internet refer to how bad it runs on iPhone and the lag times. I have spoken to Apple on several occasions about my dissatisfaction with its firmware but it won't or is unwilling to help. Its line is 'Sorry once you update you cant go back.' What a pathetic response. There are numerous people still running iOS 6 on their iPhones so its still supported. Because there is no longer a digital signature for the firmware it comes back with a fault. Apple should enable people to revert back to previous versions if they believe the software doesn't run well on their phones.

APC why don't you pick this up and run with it and help a lot of people, maybe then Apple might come to the party?
John Finlay

CORRECTION

In APC's February issue, a mix up in production resulted in the MSI Z87I Gaming AC motherboard review running with the wrong image. We apologise for any inconvenience this may have caused.

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Come on, have your say!

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Apple's iWork productivity suite has gone multi-platform... but at what cost?

Update schmupdate

When software revisions lead to buggy products, nobody's happy. But worst of all? Radically dumbed-down redesigns that butcher the original program.

In theory it should be a good thing when developers issue updates for their software. Updates mean new features, enhanced old features, streamlined interfaces, performance can be improved and bugs can be fixed. New builds give makers a chance to evolve and hone their product, and, at the end of the day, software updates should be something to look forward to.

If only it always worked out that way. While the majority of software revisions happily entail most of the above, sometimes updating your apps is a risky and even downright unadvisable thing to do. Why? Because while software developers tend to always be very upfront about what new stuff they're putting into their software, they're not always so forthcoming about *what old stuff they're taking out*. And in today's era of download-only software – where the vast majority of programs are distributed entirely via digital channels – hitting the update button can be a perilous gamble.

Apple's a company that knows this territory well. In 2011 it infamously updated its high-end video-editing software, Final Cut Pro, with a new, streamlined version, Final Cut Pro X, which was seemingly redesigned, sporting a simplified feature set and removing several fundamental aspects of the program. Professional video editors in the film and TV industry – who relied on the legacy app for their work – were outraged, panning the new release (which they dubbed 'iMovie Pro') and demanding refunds.

Yet Apple's experience with the controversy surrounding Final Cut Pro hasn't affected its reformist zeal when it's got a software agenda to pursue, with the latest user squabbles centred around productivity suite iWork. In October last year Apple radically overhauled the Mac versions of iWork's Pages (word processor), Keynote (presentations) and Numbers (spreadsheeting) apps in order to bring them further into line with their iOS counterparts. Unfortunately, the only way to do this was to excise a huge amount of features and formatting tools that users deemed indispensable.

> "Apple's experience with the controversy surrounding Final Cut Pro hasn't affected its reformist zeal when it's got a software agenda to pursue."

Months later the fallout continues – despite Apple's varying promises to bring some of the iWork features back – with reviews on the Mac App Store displaying a litany of one-star ratings and user put-downs. Take Pages, for example: "Very muddled", "It's a degrade not an upgrade", "Dumbed down and unusable", "Loved the old, HATE the new", "The best word processor I ever had... RUINED... No words...". And so on.

So next time you're about to update your software, look before you leap. Read the system requirements, the ratings, the user reviews, the professional reviews. Then double-check them, wait a week... and check them all again one last time. And remember: once you hit update, there's usually no turning back. ■

ENDUSER

Share the hilarity!

Do you work in the IT industry and are forced to deal with inept and clueless end users on a daily basis? Do you have an IT professional, who isn't that 'professional'? If you have an interesting or amusing story, email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

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AMD A10-7850K

New process, new technologies, same old AMD...

We've been talking about the Kaveri technology in this A10-7850K for a long time now – about the promise of those new Steamroller cores, the addition of Graphics Core Next GPU cores, and the still rather intangible benefits of the heterogeneous system architecture. Now it's here, in its shiny new heatshield, with those copper pins gleaming in the light of a new day, we're still, in some ways, waiting for it to arrive.

The initial performance of this new, advanced silicon is somewhat immature and we're still waiting for real-world instances of HSA software to take advantage of the new compatibility that's been built into Kaveri. So despite the actual hardware being ready and available, the ecosystem as a whole just doesn't seem to be ready. It's a shame because we wanted to be jumping into our Kaveri testing with enthusiasm for AMD's resurgence as a fighting force in the PC processor market.

Let's just recap what that hardware is. The A10-7850K is rocking new, upgraded Bulldozer cores.

Codenamed Steamroller, this update aims to fix a problem that's always been holding back the AMD CPU architecture – weak individual core performance.

Steamroller gives each of those cores more of its own resources so it can operate more effectively as an individual unit, while still using its multi-threading abilities. This top Kaveri component is utilising a pair of Steamroller modules, effectively making it a quad-core part.

NEXT: GRAPHICS!

The other half of the equation is the graphics. Well, not quite half, but at 47% of the Kaveri die being given over to Graphics Core Next silicon it's a healthy boost over both its predecessor, Richland, and the latest Intel Haswell processors, which both dedicate less of their dies to graphics.

The move from the older VLIW4 graphics architecture to the modern GCN tech is important too, and, combined with a process shrink from 32nm down to 28nm, means we've got a rather impressive-looking 512 GCN cores inside the unassuming APU. Richland's A10-6800K only had some 384 of the older cores inside, so Kaveri's graphical power should be well in advance. As for the CPU part though, AMD has decided to set the A10-7850K's GPU clockspeed lower than its predecessor; here it's 720MHz versus 844MHz, which offsets the performance gains to some degree.

This is something that really confuses us – especially given that this is AMD's top desktop APU part, and not a chip that really needs to fit inside a particular power envelope.

For all our talk of four CPU cores and 512 GCN cores though, AMD doesn't want us to think about its APUs like that. AMD wants to talk about compute cores. Under that moniker it counts each CPU core as a compute core, and on the graphics side each compute unit gets the same treatment. The compute unit is made up of 64 GCN cores, giving the A10-7850K eight of them. In total, that means AMD wants to denote this APU as a 12-core part.

That might seem like marketing donkey dung, but in light of the software advantages of the new Kaveri architecture, it makes sense. The whole idea is that HSA software will essentially be blind to the CPU/GPU divide, and will just use whichever compute core is best suited to its task.

That's possibly the most exciting part of Kaveri, and it could be a killer app for the new APU. The same can

be said of the Mantle API that AMD is working on. That can allow for the APU to be used in conjunction with whatever discrete GPU you use to offset workloads like particle effects to boost gaming performance.

PRESENT TENSE

But what about right now? This A10-7850K is not delivering the sort of performance we want from all the new tech that AMD has dropped into the APU. You can pick a bunch of synthetic benchmarks that focus directly on some key parts of the silicon alone, and you can play with a selection of early HSA tests that prove its eventual benefits, but in the real-world it's not as big of an advance over Richland as we were hoping.

That can be partially explained away by the drop in clock speeds across the board. The A10-7850K is rated at 3.7GHz, Turbo-ing up to 4GHz when possible. We didn't see it manage 4GHz on either of our testing motherboards, with the latest beta BIOSs direct from AMD. Richland, however, is happily running at 4.4GHz whatever CPU tests we throw at it. In Cinebench, the Kaveri chip is generally running at around 3.8GHz at best – that's some 600MHz slower, and almost kills any advantage the Steamroller cores might offer.

We ran the A10-7850K at 4.4GHz though and saw a 10% boost in Cinebench, but that's still a way off the 30% boost that AMD has been claiming.

Gaming is where we see most of the performance boosts at stock speeds though, with the A10-7850K offering a 10-15% improvement over the A10-6800K in the CPU-intensive *Battlefield 4*. It still can't keep up with Intel in that department, with even the Core i3-4130 beating Kaveri across the board when using a discrete GPU for gaming.

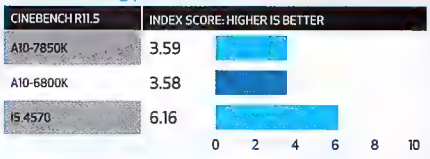
For the integrated GPU it's a different story. The GCN graphics of Kaveri are a good deal quicker than the HD graphics of any of Intel's desktop chips, and are actually capable of delivering a good 1080p gaming experience. It's around 10% quicker than its Richland predecessor, with a slower clockspeed on the graphics cores, too. You can push that above 20% with a little light overclocking of both the system memory and GPU cores – we were hitting almost 40fps in GRID 2 at 1080p, on high settings with 4x AA.

So, where does that all leave us? Paired up with a discrete graphics card – and with nothing currently running the Mantle API – the A10-7850K is a difficult sell when it's so close to the Core i5-4570 in price, and motherboard costs aren't much different between H87 and A88X chipsets. Intel still has dominion over gaming PCs while the software still favours its hardware, but Kaveri is genuinely an option for an integrated system, sans discrete card. It's faster than competing Intel GPU silicon and has a decent advantage over older AMD APUs too.

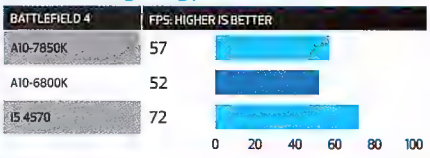
But at the moment we still can't recommend it. It simply isn't ready. The promise of both HSA software and Mantle is huge and tantalisingly close, but those are going to power the killer apps that make the AMD APU a really viable alternative to Intel in most markets. At the moment the integrated arena is the only place that AMD can claim a definite lead. ■ **Dave James**

LABS BENCHMARK RESULTS

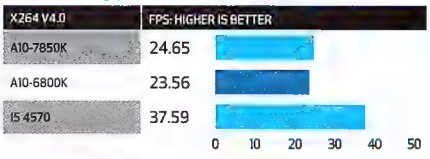
CPU rendering performance



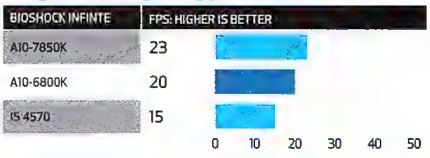
Discrete DX11 gaming performance



HD encoding performance



Integrated DX11 gaming performance



"The compute unit is made up of 64 GCN cores, giving the A10-7850K eight of them. In total, that means AMD wants to denote this APU as a 12-core part. That might seem like marketing donkey dung, but in light of the software advantages of the new Kaveri architecture, it makes sense."

Verdict

Features ★★★★½
Performance ★★★½
Value ★★★★½

The fastest integrated graphics around, but paired with CPU cores that are still disappointingly weak.

★★★½

AMD MOTHERBOARD

$175 | WWW.ASUS.COM.AU

ASUS A88X-PRO

Does a big, expensive board have a place in the APU ecosystem?

The AMD Kaveri APUs are finally here, but processor silicon needs a good motherboard to drop it into. We've got a pair of them to play with, each with a brand new BIOS straight from AMD itself. One is ATX and the other is mini-ITX, so how does the new silicon fair when it's slotted into these boards?

The ASUS A88X-Pro is as top-of-the-line as you're going to get in Kaveri motherboards. It's rocking the full monty when it comes to the AMD mobo feature set. There's the full line-up of SATA 6Gbps and USB 3.0 support, the new FM2+ socket and a pair of full-length PCIe 3.0 slots with CrossFire support, and it's replete with ASUS's latest golden heatsink design for that bling factor. It's a bona fide ATX board, so it'll fill out any of your choice of chunky chassis, but is the ATX form factor where Kaveri belongs?

BE DISCRETE

The big problem for the latest A10 APUs is that their performance with discrete graphics cards isn't very good, especially when you put them up against the latest Haswell CPUs from Intel. We're not talking about the overclocking-happy K-series chips here – the $230 i5-4570 only costs a little more than the top A10-7850K, and utterly hoses it in terms of discrete gaming performance. And when you're talking about a mobo like this A88X-Pro, which is retailing for over $100, the platform price benefits of AMD over Intel start to vanish.

It's not even like the bigger board offers that much of a tangible benefit over the mini-ITX ASRock (right), which costs a lot less. The extra scale doesn't deliver any extra CPU performance either. In fact, the ASRock board is slightly quicker in Cinebench and will overclock just as far.

Gaming performance is where ASUS has a traditional advantage, and that's born out by our benchmarks using both a discrete card and the integrated graphics of the A10 APU. There's not much in it, but it's quicker than the ASRock.

While the integrated performance is welcome, the discrete performance is almost irrelevant for most of us. Unless you plan to match it with a low-end card for use with the asynchronous CrossFire tech (which still isn't in the latest drivers at the time of writing), there's little point using this as the base for a discrete GPU-powered gaming rig. The R9 290 we've tested with is hobbled by the A10 APU compared with either AMD FX or Intel processors, and the platform price difference isn't great enough to matter.

This sort of high-end board, with its relatively high price tag, doesn't fit that well with Kaveri in our opinion. The ATX form factor is well suited to PC gaming, allowing a lot of space for a hot and heavy graphics card, but AMD's APUs aren't particularly well suited to it. Where they make sense at the moment is in small form factor machines without discrete graphics cards. That's not really ASUS's fault though, making us feel like this board has been let down by the weak CPU performance of AMD's latest silicon.

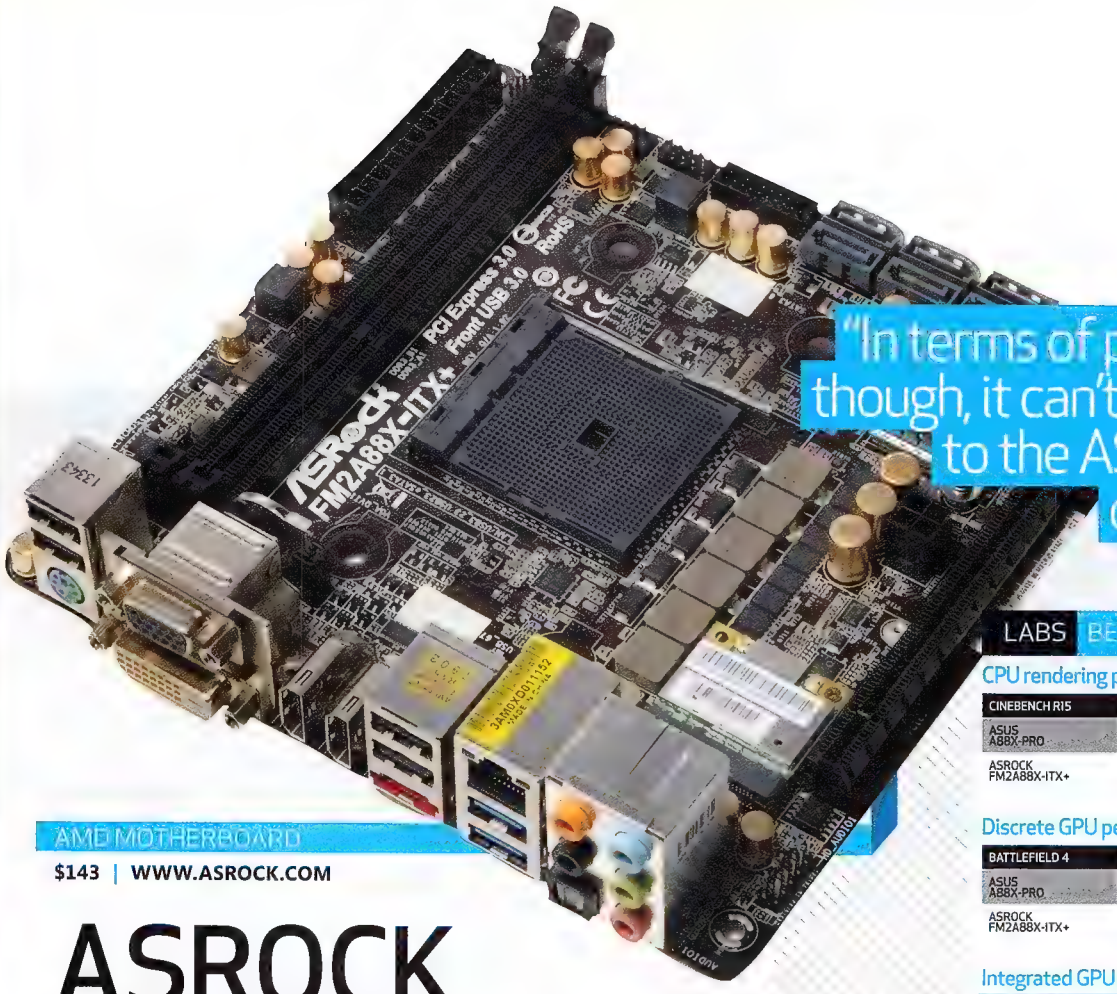
Dave James

Verdict

Features	★★★★½
Performance	★★★
Value	★★

This ATX motherboard tries its hardest, but the weak Kaveri CPU performance lets it and its feature set down.

★★★



"In terms of performance though, it can't quite live up to the ASUS-shaped competition."

AMD MOTHERBOARD

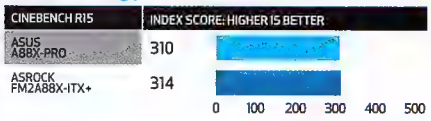
$143 | WWW.ASROCK.COM

ASROCK FM2A88X-ITX+

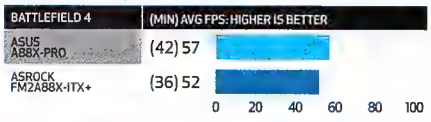
The right form factor at the right price — please tell me it performs...

LABS BENCHMARK RESULTS

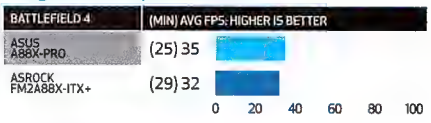
CPU rendering performance



Discrete GPU performance



Integrated GPU performance



There's something very pleasing about the ongoing small form factor revolution. We've got new mini-ITX chassis and mobos tipping up every month, all offering the promise of small form factor gaming machines with nary a nod towards compromise on anything but scale.

ASRock has put together some impressive offerings on that front recently; we've previously reviewed the H87M-ITX (see December, p47), and here we've got the FM2A88X-ITX+ just waiting to be filled with some of that new Kaveri love.

To be honest, we've had this board for a while — we've just been waiting for AMD to get its act together and release the silicon. Now it's here, and despite a less than stellar showing as a more traditional processor, there's no denying its integrated graphics performance. And the best place to drop a slice of silicon with such impressive gaming prowess is in a small form factor machine with no need for a discrete graphics card.

At $143 it's good value, with a pretty impressive feature set. It's rocking the same number of SATA 6Gbps ports as the chunkier — and more expensive — ASUS ATX board, and has a decent selection of USB options too. The full-fat PCIe 3.0 slot may also be useful once the asynchronous CrossFire tech is implemented into the AMD drivers. That will allow you to drop in a low-profile R7 discrete card to complement the R7 in Kaveri, potentially doubling the gaming performance.

SSD OR WIRELESS?

Of more use might be the mSATA/mini-PCIe slot behind the audio backplate connections. The board also ships with a little mini-PCIe Wi-Fi card, which is handy if you want a wireless network connection for your tiny machine, but personally I'd rather drop something like Samsung's latest 840 EVO mSATA SSD in there. Having both your graphics card and your storage based within the confines of the motherboard will afford you an incredibly compact, but impressively capable little gaming machine.

In terms of performance though, it can't quite live up to the ASUS-shaped competition. It has a slight edge in terms of straight CPU performance, but the A88X-Pro has a decent advantage in the gaming graphics stakes. That said, the ASRock can still manage an impressive amount of overclocking, and that's more important with a Kaveri APU than you might imagine.

Boosting the clocks on both the graphics card and the system memory will give quite a hefty boost to the gaming performance of the platform as a whole, and the ASRock will facilitate it without complaint. The BIOS is pretty basic when you compare it with the friendly ASUS offering, but it has a host of options to help you get the most from all the different features AMD has jammed into its latest chip.

Given the superior performance of the ASUS board in gaming though I have to admit I'm more intrigued by the possibility of a low cost mini-ITX from its stable, but for the time being I could happily build a little bargain machine from this ASRock offering.

Dave James

Verdict

Features	★★★★½
Performance	★★★½
Value	★★★★½

A good value mini-ITX board with all the trimmings. It just lacks the gaming performance of the ASUS boards.

★★★½

apc RECOMMENDS

"Go steady when eyeing those sequential times, though – these are used in companies' promo campaigns because they yield big numbers, but your system will hardly ever ask an SSD to perform them."

$269 | WWW.OCZ.COM

LABS BENCHMARK RESULTS

Sequential read performance

AS SSD	MEGABYTES PER SECOND (HIGHER IS BETTER)
OCZ VERTEX 460	509
OCZ VECTOR 150	497
SAMSUNG 840 EVO	494

0 200 400 600 800 1000

4K random write performance

AS SSD	MEGABYTES PER SECOND (HIGHER IS BETTER)
OCZ VERTEX 460	76
OCZ VECTOR 150	108
SAMSUNG 840 EVO	101

0 40 80 120 160 200

Real-world data transfer performance

38GB FILE	TIME IN SECONDS (LOWER IS BETTER)
OCZ VERTEX 460	252
OCZ VECTOR 150	212
SAMSUNG 840 EVO	320

0 100 200 300 400 500

OCZ VERTEX 460 240GB

An affordable drive based on the impressive Barefoot 3 controller.

Last issue we were really impressed by OCZ's Vector 150 SSD. The troubled company's first drive since it rose like a phoenix from the financial flames – courtesy of a $35 million Toshiba buyout – made reliability its point of emphasis, underlined by a five-year warranty and a purported 50GB/day lifespan for five years. That reliability made the Vector 150's read-write performance all the more impressive, knocking on the door of 500MB/s territory for both.

This Vertex 460 is a very close approximation of a thoroughbred Vector 150, constructed with a tiny bit more frugality. Like the Vector 150, this performance SSD has 12% of its total accessible area set for over-provisioning to help its Indilinx Barefoot 3 memory controller perform at full sprint, which means Windows sees 223GB of storage once you've formatted the drive.

Unlike the Vector 150, this SSD comes with a three-year warranty rather than five, and a lifespan of 20GB/day for three years. That's quite a trade-off for increased performance, so the salient question is: just what is the difference in performance between the two?

Well, this SSD boasts sequential read and writes of 545MB/s and 525MB/s – just 5MB/s slower in each than its illustrious stablemate. While those numbers prove to be reassuringly optimistic in practice, during our own benchmarking process we found the performance gap to be extremely marginal. The Vertex actually posts higher sequential read times than its pricier cousin, and this drive comes close to matching the Vector 150 in both synthetic benchmark programs and real-world file transfers.

Go steady when eyeing those sequential times, though – these are used in companies' promo campaigns because they yield big numbers, but your system will hardly ever ask an SSD to perform them. It's better to look at the 4K random write time: in this drive's case, a respectable 75.89MB/s that'll still feel zippy when running your OS install on it, but does lag behind the Vector 150 and Samsung's 840 Evo drive.

Exactly what is the hardware difference that explains the disparate reliability ratings from OCZ? The answer is, very little. Both drives use the same memory controller and NAND modules, with the Vector's Barefoot 3 clocked slightly higher at 397MHz to the Vertex's 352MHz, and the Vector's parts are checked and tested with a bit more vigour to guarantee a longer lifespan.

If your budget can't quite stretch to the Vector 150, this is an excellent alternative. After all, are you really going to be writing 20GB of data onto your SSD every day? We reckon that by just telling Windows not to thrash it with unnecessary scheduled defrags and prefetch, you'll get all the longevity and reliability you need at a price that would have prompted ugly scenes in stores a couple of years ago, when performance SSDs still came with a mighty mark-up.

Phil Iwaniuk

Verdict

Features	★★★½☆
Performance	★★★½☆
Value	★★★★½

Not as good as the Vector 150, but the price difference is considerably bigger than the performance gap.

★★★★☆

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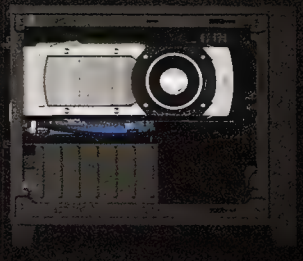
If you want to build a Mini-ITX system without compromising expansion, flexibility, or performance, the Obsidian Series 250D is your answer. Though it's small on the outside, the 250D has room for standard components like a full-size 5.25" optical drive, a full-length GPU, a 240mm radiator, and even a full-size ATX power supply.

The sleek, aluminum front fascia provides the striking yet subtle design that Obsidian Series cases are known for, and a top window gives you a close-up view of your high-performance components. The 250D is a great choice if you want full size performance in a small space.



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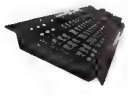
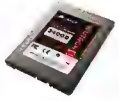
POWER SUPPLIES



GAMING KEYBOARDS



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GPU

$950 | WWW.GIGABYTE.COM.AU

GIGABYTE GV-N78TGHZ-3GD

Nvidia wrestles back the GPU performance crown.

Nvidia, in response to the success of the AMD Radeon R9 290X, has released a tweaked version of the 780, the GTX 780 Ti. The first of the aftermarket 780 Ti cards we've tested is a Gigabyte model that uses a Windforce 3x coolers.

The card is visibly almost identical to the GHz Edition we tested previously, but that's where the similarities stop. The 780 Ti features a base GPU clock of 1,085MHz and a boost clock of 1,150MHz, this is backed by a ridiculous memory frequency of 7,000MHz. That's up from 863, 900 and 6,000MHz, respectively. The upgrades don't end with frequency bumps either; stream processors have been increased from 2,304 on the 780 to 2,880 on the 780 Ti and texture units are also bumped from 194 to 240. In short, if the GeForce GTX Titan was in a coffin when the 780 was released, it is well and truly buried now the 780 Ti is on the market.

The performance comparisons aren't even close. Across an array of synthetic benchmarks including Heaven and the 3DMark suite, we see a 15% to 20% performance increase over the 780, with an impressive 8-15% increase over the Radeon R9 290X. Very similar gains are seen in gaming benchmarks.

The 780 Ti is the AMD killer that the 780 should have been. Nvidia has hit back in the performance stakes, although we aren't quite convinced the 15% performance gains are worth a 25% price hike over the AMD 290X. That said, if you're spending $750 on a graphics card in the first place, a stretch to $950 isn't that big an ask...

James Trevaskis @teamau

Verdict

The 780 Ti is a definite 290X killer, but the performance doesn't quite match up with the asking price.

★★★★½

GPU

$770 | WWW.GIGABYTE.COM.AU

GIGABYTE GV-R929XOC-4GD

AMD does its best to tame Nvidia, but comes up a little short.

AMD has been under pressure in recent times. As soon as it manages to gain an advantage, Nvidia releases a new product to steal the top spot. This is great news for consumers, as it forces AMD to keep inventing. The first of the re-invented R9 290X cards we've tested is this Gigabyte model – and it packs a punch.

Improving on the stock AMD heatsink is Gigabyte's quality Windforce cooler. This makes a huge difference: on a stock 290X we witnessed temperatures of over 90°C under load, while Gigabyte's never peaked above 75°C. This increased cooling capability has allowed Gigabyte to push the GPU frequency from a stock clock of 1,000MHz to an aggressive 1,040MHz. It's a much bigger advantage than it seems, as the enhanced cooling capacity allows the card to stay at maximum frequencies for much longer. That adds up to faster and more consistent frame rates.

On the other hand, even this overclocked R9 290X still doesn't get close to the GTX 780 Ti, scoring between 10 to 20% lower across all of our benchmarks. However it does gain more than 11% when compared with a stock 290X, with headroom for additional improvements with further overclocking.

We are slightly disappointed with the price-to-performance ratio of this card, considering that some 780 Ti's perform around 15% higher for a mere 10% price increase. Overall, there's no denying this is a seriously impressive card with more than enough game rendering capacity for all but the most frame hungry gamers.

James Trevaskis @teamau

Verdict

A gaming beast that exploits the untapped potential of the R9 290X core, but it's a little overpriced.

★★★★☆

apc RECOMMENDS

GRAPHICS TABLET

$350 (MEDIUM SIZE) | WWW.WACOM.COM

WACOM INTUOS PRO

Wacom remains the professional standard.

While there are a few companies who make graphics tablets, the reigning king has long been Wacom. Things haven't changed dramatically in its lineup since the Intuos 4 in terms of features, but the Intuos Pro series now includes wireless functionality, and the size of the medium tablet has been reduced in dimensions, weight, and drawing area. Also gone are the LED displays, replaced with a heads-up display on your computer screen.

Like the previous iteration, the Intuos Pro offers 2,048 levels of pressure sensitivity, which is essential for fine-tuned control, and the bundled stylus includes a desktop stand that holds the included stylus tips – 11 in all. The feel of the Wacom tablets has yet to be bettered, and the bar remains high with this version. The software support is extensive; you can highly customise the response of the pressure sensitivity, and there are six buttons along one side of the tablet's face, plus a circular control dial and central button, all programmable.

The Intuos Pro can also double as a multitouch trackpad. Perhaps our only quibble here is that you can't use the trackpad and stylus simultaneously – you need to pull the stylus away, lay your fingers down, pinch to zoom into your artwork (or one of many multitouch operations), and bring the stylus back in to continue.

When using the tablet wirelessly, we noticed no lag in responsiveness; the battery lasted an entire day's worth of wireless work without running out of juice. We weren't thrilled with the fit and build quality of the bundled USB cable, which is necessary for charging the battery and using the tablet in wired mode.

It's not an earthshaking update, but this latest generation continues to provide everything that's good about Wacom's technology, adding wireless connectivity and trackpad functionality without increasing the price. We'd love to see a better USB cable and port design, but overall, if you're a digital artist looking to get your ideas into your computer, this tablet is a sure bet. ■ **David Biedny**

Verdict

Features	★★★★
Performance	★★★★
Value	★★★★

Excellent stylus sensitivity. Strong software support. Wireless feature now standard.

★★★★

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4K MONITOR

$1,499 | WWW.DELL.COM.AU

apc RECOMMENDS

DELL ULTRASHARP UP2414Q

Sharp as a katana, but does anyone have the power to run it?

Call it 4K. Call it Ultra HD. Either way, massive pixel counts are the next big thing – and if there's any device that can make the most of 4K, it's the PC monitor. Dell's new UltraSharp UP2414Q is the third of these 4K screens we've seen and it sports the same 3,840 x 2,160 resolution as the 31.5-inch ASUS PQ321 and Dell UP3214Q. However, this new Dell costs just $1,500 – less than half the price of the others. The caveat is that it's only 24-inches.

When it comes to broader specs, things get a little wobbly too. Dell describes this panel as IPS, whereas its rivals use IPS IGZO panels. But we've seen reference to the UP2414Q being IGZO too, so we think it's both IPS and IGZO as well. Other metrics are typical IPS fare: 178° viewing angles, static contrast of 1,000:1 and 8ms response times. It's LED backlit, brightness is rated at 350cd/m², and there's a super-fine pixel density of 185ppi. As for inputs, you get HDMI, plus mini and regular DisplayPort (it's only those two that offer 4K operation). The chassis offers tilt, rotate, swivel and height tweaking.

So what's it like to look at? Utterly stunning. The epic 31.5-inch 4K screens can't match the crispness that you get from cramming all those pixels into a 24-inch panel. You can't see the individual pixels, which gives images a wonderfully seamless feel.

The colours are gorgeous too. The same goes for the results in our objective tests. Gradient rendering, viewing angles, white and black scales are all immaculate.

Then there's actually using this 4K beauty. There's not much 4K video to watch, but what is available is utterly beautiful, though it more or less ruins 1080p for you.

The same goes for gaming, though here it's a little more complicated. We paired the UP2414Q with an Nvidia GeForce GTX 780 Ti, the fastest single graphics card you can buy. Even it can only just cope with that colossal native res in modern games.

You're looking at around 50fps in *GRID 2*, for instance, and just 15fps in *Metro: Last Light*. In short, you'll need some truly epic graphics hardware, and even then, you'll have to compromise. Frankly, the PC isn't quite ready to game in 4K. It's close, but it will probably take the next generation of GPUs to enable compromise-free 4K at the high end.

Speaking of technologies that aren't ready for 4K, you can add Windows to the list. At native res, with standard Windows DPI and font size settings, everything looks preposterously tiny, even with Windows 8.1.

Fiddle about with scaling and you'll still hit problems. While many core elements of the 8.1 interface scale nicely, most third-party apps look terrible. What you get is a blurred, blown-up, soft and fuzzy bitmap. The same goes for nearly all web pages and the Steam interface.

So, this 24-inch 4K screen is in a tricky position. It looks absolutely stunning, but at this stage we're waiting for other bits and pieces to catch up. Instead, it could well be Dell's next 4K screen, a 28-inch effort with a TN panel and a $900 sticker, that makes ultra-HD a practical, affordable prospect for the desktop PC.

Jeremy Laird

Verdict

Features	★★★★½
Performance	★★★★☆
Value	★★★☆☆

A fantastic monitor that's sadly a little ahead of its time in terms of GPU and operating system support.

★★★★☆

apc
HOT PRODUCT
"The colours are vibrant but not over-saturated, and the whites are super clean. The anti-glare coating is nice and smooth too, so there's zero annoying sparkle to contend with."
27-INCH MONITOR
BENQ

$849 | WWW.BENQ.COM

BENQ BL2710PT

A great monitor, if only the price wasn't quite so high.

The scarcity of outfits that make LCD screens is a bit of a pain. We're talking about panels, not fully finished monitors with chassis, stands and image-processing electronics. Anyone, seemingly, can sling one of those together.

But knocking out the panels themselves? Apparently that's the work of billion-dollar fabrication facilities, which means very few companies can get in on the action. That's a problem, because it makes for less choice and competition.

It's an issue that particularly afflicts high-resolution PC monitors. If you cracked open a sample from all the mainstream market segments, you'd find that the vast majority of panels originated from three or four companies.

Those numbers are even slimmer for high-res clobber. Until recently, for instance, all 27in monitors with 2,560 x 1,440 pixel grids used an LG-manufactured panel, with one exception. Samsung also makes its own 27in high-def panels, but we're not aware of any third party screens using the Samsung version.

Net result? Samsung or LG were the only options, and prices were higher than we're comfortable with. That's the context for the very welcome arrival of this BenQ effort. It's a 27in 2,560 x 1,440 item. And it sports neither an LG nor Samsung panel. Yup, at last we have a new supplier. Hurrah.

Even better, that supplier is none other than AU Optronics. In our experience, it deals in high volume, competitively priced panels. Its output hasn't always been of the highest quality, but it's significant that it thinks there's sufficient demand to get in on the 27in action.

The panel is AU Optronics' AHVA tech. It stands for Advanced Hyper-Viewing Angle, and it's essentially a type of IPS panel. That's exactly what it looks like, and it's gorgeous from the moment you fire it up. The colours are vibrant but not over-saturated, and the whites are super clean. The anti-glare coating is nice and smooth too, so there's zero annoying sparkle to contend with.

The objective metrics are good, but not perfect. Some banding is visible in gradients and at default settings there's a whiff of compression in the white scales, though it's easy enough to dial that out.

The viewing angles might just be the best we've seen from any LCD panel. There's little to no evidence of the annoying glow that can blight conventional IPS panels. Then there's the sturdy, fully adjustable stand and the nice, slim bezel. This is a proper piece of kit, albeit a pretty anonymous all-black design.

We should also note that this monitor is one of BenQ's new flicker-free models, so it doesn't use pulse-width modulation to control the backlight. However, our stance is that backlight flicker isn't an issue for most people.

There's just one snag: it costs over $800. Admittedly, BenQ is aiming this panel at the pro market and it's good value in that context, but for now, at least, AU Optronics' debut into the 27-inch segment hasn't quite hit the price level we'd like.

Dave James

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★

Verdict A warm welcome to a new 27in panel maker. New AHVA tech is lovely, but not as cheap as we'd hoped.

★★★★½

"God knows what we would have thought of it back in 2003. We'd have probably spontaneously and collectively spasmed at the sight of a 27in LCD panel with 2,560 x 1,440 pixels."

27-INCH MONITOR

$915 | WWW.VIEWSONIC.COM.AU

VIEWSONIC VP2770-LED

A return to the quality ViewSonic monitors of old.

apc RECOMMENDS

Wind back the clock to the early days of the LCD monitor around a decade ago and it's amusing to recall how futuristic and exotic the likes of a thin-bezel ViewSonic 19in panel looked and felt.

It seemed huge, in part thanks to the fact that a 19in LCD monitor was just that – 19 inches. A 19in CRT monitor meant a viewable screen at least an inch smaller. The LCD was totally flat, super sharp and quite simply the future.

It was also competitively priced, which has always been ViewSonic's thing. However, ViewSonic seemed to shift to more of a commodity-spec strategy, with endless cheap monitors based on generic TN panels. The odd thin-bezel monitor remained in the VP range, but they never seemed to offer very good value.

The VP2770-LED is a return to the best ViewSonics of old. Indeed, it's amusing to note that the design vibe hasn't moved on much. What worked a decade ago still flies today.

That means clean styling and a thin bezel, the latter accentuating this screen's 27-inch proportions. God knows what we would have thought of it back in 2003. We'd have probably spontaneously and collectively spasmed at the sight of a 27in LCD panel with 2,560 x 1,440 pixels.

Anyway, another welcome quality is a fully adjustable stand with height, swivel, tilt and, yes, the ability to rotate into portrait mode. The latter is admittedly of niche utility, but a fully adjustable stand is a reminder that corners haven't been cut. This is a serious bit of display technology.

Fire her up, though, and you might be a bit disappointed. Is this panel a little dull? The LED backlight is no scorcher, but in reality, the highest settings of brighter panels are usually redundant. In normal home or office conditions, you're aren't going to be running max brightness anyway.

What's more, LED backlights don't go off like CCFL tubes used to, so having a little headroom to spare as the backlight dims with use isn't an issue, either. Once you're over that little hump, you begin to appreciate the quality on offer.

The colours are lovely and subtle rather than in-your-face. This display doesn't need to impress with cheap visual gimmicks. It renders nearly perfect gradients and flawless white and black scales. There's no edge bleed from the backlight, either. This display has been properly assembled.

As you'd expect from an IPS screen, its viewing angles are excellent, if not quite as expansive as the BenQ and its super-wide angle AU Optronics panel. There's only a whiff of IPS glow, so the gap between this and the BenQ in that regard is probably academic.

It's good to see three levels of pixel response in the OSD menu. The middle setting gives a great compromise with no inverse ghosting or discernible lag. Great for gaming. Overall, this isn't the best display we've seen. The Dell's 4K UltraSharp UP3214Q takes that accolade... although it's even more expensive at $3,500.

Dave James

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

Gimmick-free and honed for the job, the VP2770 is a Viewsonic out of the old school. That's a good thing.

★★★★☆

apc RECOMMENDS

PC CASE

$125 | WWW.CORSAIR.COM

CORSAIR OBSIDIAN 250D

As black and as solid as the igneous rock it's named after.

The 250D is very much a case of function over form, and all the better for it. That doesn't mean it's unpleasant to behold, but it's designed to be as robust and easy to build in as possible, first and foremost.

It's also been put together with the knowledge that a compact chassis needs efficient cooling. The layout has the PSU and HDD trays on the base of the case, with the mini-ITX motherboard mounted horizontally on a tray above them both. There's a decent gap between the mounting points and the front of the 250D, which allows space for both a full-length graphics card and a hefty PSU should you so desire, as well as the cabling for both.

The PCIe power connections on a lengthy GPU might be a bit of an issue if you add an optical drive to the mix (the drive tray would sit directly above any power sockets mounted on the side of the board rather than at the end), but to keep such beefy hardware chilled, Corsair has added a 140mm intake fan at the front and a side-mounted 120mm exhaust fan on the opposite side to the GPU position.

You can remove the sides and roof of the 250D to make installation as simple as possible, opening things up to access the motherboard area. Take out the optical tray and you've got almost completely unfettered access to the innards.

The Obsidian 250D may not have the stylish good looks of, say, the EVGA Hadron Air, but you can't fault its classic Corsair design and build quality. You're certainly going to lose less finger flesh building a machine into it, too...

■ Dave James

Verdict

A robust case with plenty of room to build a system into without any cursing and scraping of fingers.

★★★★☆

PC CASE

$190 | WWW.LIAN-LI.COM

LIAN-LI PC-Q30

Heat will be an issue in this case, luckily you'll only be using SFF gear.

Lian-Li makes some interesting chassis, but I have to admit I've not been a massive fan of its echoey, brushed aluminium designs in the past. At least it's tried to do things differently here – even if the name is about as boring as a sand worm.

The swept-back design and perspex front make this mini chassis look like a presentation case, but showing off the small components inside your rig isn't a bad thing. The mobo mounts on the rear wall, just above the only active cooling in the chassis: a 140mm fan set behind the board.

Cooling is the biggest concern with the Q30. You're restricted to using low profile air coolers – no water cooler will fit inside the tight confines of this chassis – and despite the vents on three sides, you're not going to get much in the way of airflow across any of the components. However, considering you're going to be restricted on the capacity of your PSU (SFF jobbies all the way here) and the length of your graphics card, chances are the components aren't going to be generating a huge amount of heat.

I've been talking a lot about restrictions, and that's what this form-over-function design demands. The 250D opposite doesn't really put any limitations upon what you build your mini-ITX machine with, aside from the requisite motherboard form-factor itself. Still, frustratingly restrictive layout aside, I can't help but have a soft spot for this odd little case. It's rather expensive and not particularly accommodating to a serious gaming build, but that swept-back design retains a certain amount of panache. ■ Dave James

Verdict

Its layout is restrictive in what you can do, but it's form over function, so that's to be expected.

★★★☆☆

ASUS®

For more information on the ASUS monitor range, scan the above QR code with your phone or tablet, or visit www.asus.com/au/Monitors_Projectors.

The MX299Q is an ultra widescreen monitor that gives a truly cinematic feel to watching movies at home.

ADVERTISING FEATURE

Monitors 101

Discover how to pick the right monitor for your needs with this handy guide.

Computer monitors come in many different guises. Choosing the best one for your situation can be tricky. Brought to you by ASUS, this guide will help you make sense of panel types, feature sets and overlooked extras, to find your perfect monitor.

MONITOR TECHNOLOGY JARGON

Some of the terms and hardware names used can be complex and a little confusing. To help make it simpler, we've compiled a reference guide for you.

Response time

The time it takes a pixel to change from one state (grey) to another and back again, measured in milliseconds. The lower the time, the less latency the display has. Although it's not noticeable during day to day use, gamers prefer the fastest time possible – 5ms or lower.

Refresh rates

This represents how many times the image on the screen is refreshed each second – measured in hertz. Most displays use a 60Hz refresh rate (60 times a second), this limits the frame rate viewable to 60fps. 3D and some gaming monitors use faster rates such as 120Hz to ensure a smooth and quick response while gaming.

Resolution

Measured in pixels, resolution is the number of horizontal pixels by the number of vertical pixels. For example, 1,920 x 1,080 is a grid of 2,073,600 pixels; 1,920 pixels wide and 1,080 pixels high. The higher the pixel count, the smoother the object is to the human eye. This also relates to the aspect ratio, which details how wide compared to how tall a monitor is – in this case, 16:9.

Pixel density – PPI, or pixels per inch.

Pixel density is how tightly the pixels are packed per inch. Higher density creates a clearer, sharper looking display, which is important when viewed close up.

Viewing angles

Monitor screens are best viewed straight on. If you start to view the display from different angles, the image will not look correct due to the colours starting to shift. Viewing angles are measured in degrees, such as 170°(H)/160°(V). This means if viewing at the correct angle, the colour will not be shifted. Therefore the wider the viewing angle, the better.

Colour gamut

Also known as colour saturation and measured as a percentage, such as 99% of Adobe RGB. This means that the monitor has excellent colour reproduction and can display almost all the Adobe RGB defined colour range. In some cases, monitors can display more than a defined colour range – for example 120% of the NTSC gamut. Higher percentages are better and monitors such as the ASUS ProArt series are designed to recreate as wide a range of colours as possible.

PANEL TYPES

Monitors use a wide range of panel types depending on their application. Knowing the pros and cons of each will help you to select the best monitor.

IGZO – Indium Gallium Zinc Oxide

A new high-end panel that combines a better pixel density (PPI) with lower power consumption. Found in the very high-end 4K UHD resolution displays, such as the ASUS PQ321QE.

IPS – In-Plane Switching

Provides more accurate colours, better viewing angles but slightly slower response times. There are many different grades of IPS – AH-IPS is currently at the top of the range, which delivers higher colour accuracy, better resolution and PPI. It can be found in the ASUS ProArt series.

TN – Twisted Nematic

Found in most general computing monitors, TN panels focus on the fastest refresh rates, lower response times and a more affordable price tag. While colour accuracy and viewing angles are lower than the

The PA279Q and its ProArt series siblings give unparalleled colour accuracy for graphics designers and professionals.
The VG278HE is the ultimate ghost-free gaming monitor. It also supports NVIDIA 3D Vision.
The high end stand on the PA279Q even lets you swivel your monitor into portrait mode for total flexibility.

high-end models, they are perfect for day to day use.

ASUS MONITOR SERIES'

With monitors designed for professionals through to gamers, ASUS has helped make it easy to choose the best monitor for your individual uses by grouping them into different series.

ProArt series

The ASUS ProArt Series is designed for graphic designers and those who need to get the absolute best from their monitors. It is designed to provide stunning colour accuracy – up to 99% of Adobe RGB, 100% of sRGB and 120% of the NTSC colour space. With up to 10-bit IPS screens, the monitors also provide a wide 178° viewing angle and feature resolutions up to 2,560 x 1,440.

ASUS ProArt PA279Q

- 27-inch 2,560 x 1,440 resolution
- 10-bit AH-IPS panel
- Response time: 6ms
- 0.2331mm pixel pitch
- 100,000,000:1 contrast ratio
- 178°(H)/178°(V) viewing angles

Lifestyle & entertainment

For entertainment enthusiasts, ASUS also has a wide range of 27- and 29-inch monitors available. The 27-inch MX279H uses a high-end IPS panel with full HD 1,920 x 1,080 resolution. For widescreen movie perfection, the 29-inch MX299Q has an ultra-wide 21:9 aspect ratio and a huge 2,560 x 1,080 res. Both also have built in SonicMaster Technology – speakers developed with Bang and Olufsen ICEpower, for excellent audio quality. With inputs for multi-device connectivity and super thin bezels, this ASUS range is the perfect way to kick back and relax.

ASUS MX299Q

- Ultra wide 21:9 aspect ratio
- 2,560 x 1,080 resolution
- AH-IPS panel
- Response time: 5ms
- 0.2628mm pixel pitch
- 80,000,000:1 contrast ratio
- 178°(H)/178°(V) viewing angles

Gaming

The ASUS VG series is specifically designed to give gamers exactly what they need at affordable prices. Ranging from 24- up to 27-inch, these monitors use TN panels for the fastest response times with full HD 1,920 x 1,080 res. The VG278HE supports up to 144Hz refresh rate and supports NVIDIA 3D Vision. The smaller 24-inch VG248QE model features an ultra-fast 1ms refresh rate for ghost free gaming.

ASUS VG278HE

- 144Hz refresh rate
- 1,920 x 1,080 resolution
- TN panel
- Response time: 2ms
- 0.311 mm pixel pitch
- 50,000,000:1 contrast ratio
- 170°(H) /160°(V) viewing angles
- Supports NVIDIA 3D Vision

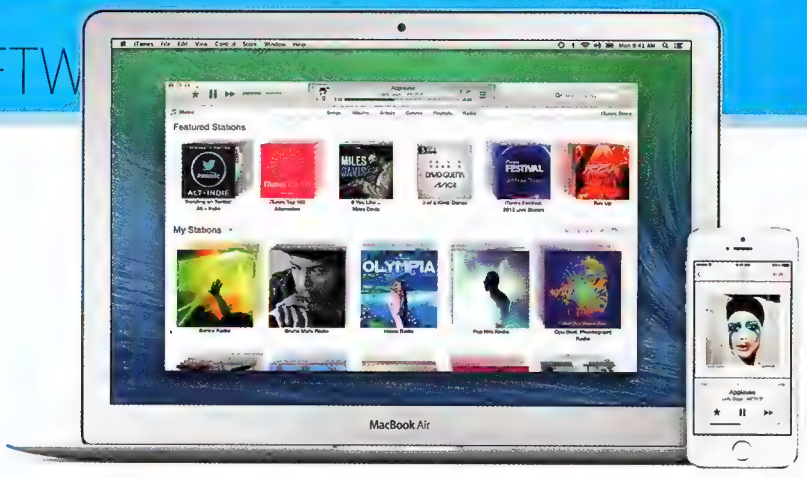
MONITOR EXTRAS

It is often easy to focus on the hardware side of the monitor, and forget about the myriad of other features that makes a great monitor. One of the most overlooked features is the monitor's stand. The most basic stand will let you tilt the monitor, whereas with the wide range of ASUS monitors, you can adjust the height as well as swivel it horizontally – making it easy to get the perfect viewing angle or work in portrait mode. The majority of the ASUS monitors also feature VESA wall mounts, so you can attach them anywhere. For gamers, a monitor with an audio output jack makes it easier to plug in headphones or remote speakers. Different ASUS monitors also have different handy extras such as USB hubs, card readers, inbuilt webcams and microphones. For those who require multitasking, some ASUS monitors also feature picture in picture modes. Not to mention, all ASUS monitors come with a 3 year Perfect Pixel Warranty, giving you peace of mind while enjoying your ASUS display experience.

software

» APPS FOR ALL THE MAJOR PLATFORMS BY PETER DOCKRILL

Windows SOFTW



iTunes Radio

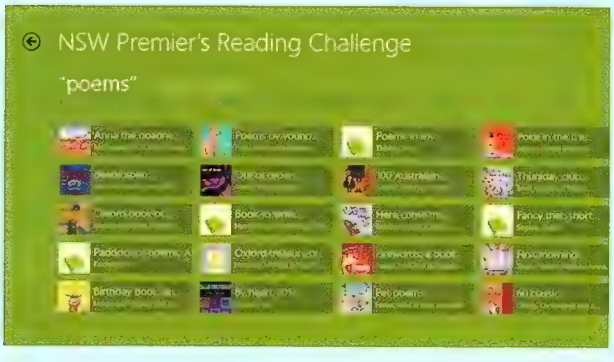
Another streaming music service... but this one enjoys home court advantage.

FREE | APPLE | WWW.APPLE.COM/ITUNES

A few years ago streaming music was something we could only read about: an entertainment technology available overseas, which, for various licensing reasons, wasn't on offer in Australia. Then the floodgates suddenly gave way, and Spotify and its numerous rivals opened up shop here, giving local users almost too much choice. A couple of years on, Apple has released its own take on music streaming, iTunes Radio.

Unlike on-demand services — which let you pick any song, artist or album and listen to your selection at once — iTunes Radio, as the name suggests, is more like a smart internet radio station in the vein of Pandora. A number of featured stations are available (commercial hits, alternative hits, retro hits, featured artists and so on), or you can create your own stations based on particular genres, artists or songs. The service becomes more personalised the more you use it, and you can instantly buy any songs if you like them. Cha-ching!

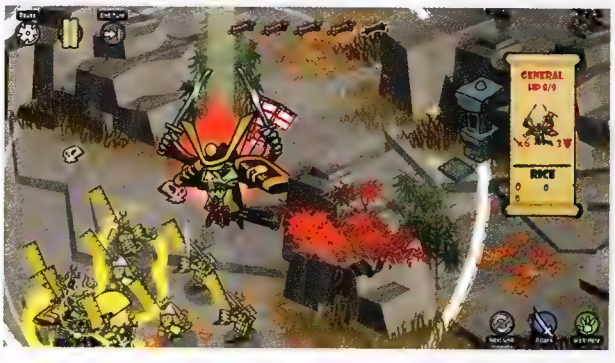
What separates iTunes Radio from its many similar competitors is... you've probably already got it installed. Rather than requiring you to download a separate app and/or sign up for a new account, iTunes Radio is already freely available as part of the standard desktop iTunes app presently sitting on many PCs and all Macs — although you may need to update to the latest version to see it. (It's similarly pre-baked in to the Music app for iOS and Apple TV users.) This savvy, frictionless rollout means there's very little barrier to sampling the service for literally millions of Australian users — a significant advantage in a crowded streaming marketplace. iTunes Radio is free with occasional ads, or ad-free for iTunes Match subscribers.



NSW Premier's Reading Challenge Preview

FREE | DEPARTMENT OF EDUCATION AND COMMUNITIES | TINYURL.COM/LS7O76F

Learning to read well — and to enjoy reading — is a crucial part of the development of young children, and it doesn't help that these days there are so many digital distractors that come between our kids and a good book. Luckily, this app is one digital effort devised to reverse the trend. The Premier's Reading Challenge is a NSW government initiative designed to encourage young readers to explore quality books and literature, and the official app helps kids keep track of what they're reading and their progress in the course, along with statistics and information on the books involved.



Skulls of the Shogun

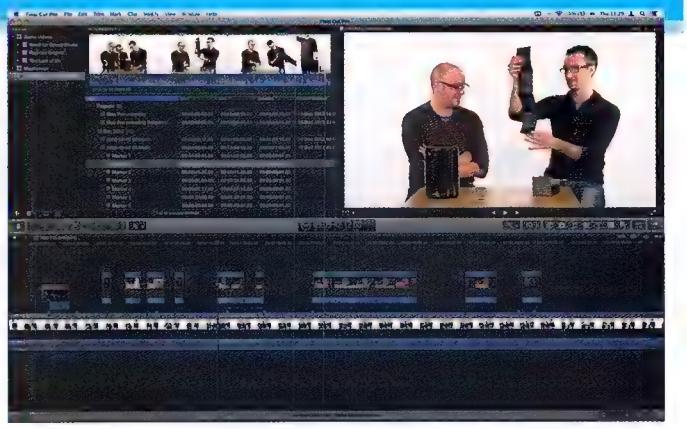
FREE TRIAL / $4.49 | MICROSOFT STUDIOS | TINYURL.COM/P8S2NVN

Strategy games are one of our personal addictions in the *APC* office, but their perceived complexity ensures it's not always the most accessible or inviting genre (which can be a turn-off for some). If that sounds like you, try *Skulls of the Shogun* on for size. This riotous strategy-light title offers an intuitive, easy-to-learn control scheme to suck you in — not to mention lashings of silly humour within an absurd samurai warlords afterlife scenario — and before you know it you'll be smack bang in the middle of a challenging war game... and loving every minute of it.

Final Cut Pro X 10.1

Three years (and versions of OS X) later, is FCP X finally worth using?

$299 | APPLE | WWW.APPLE.COM/AU



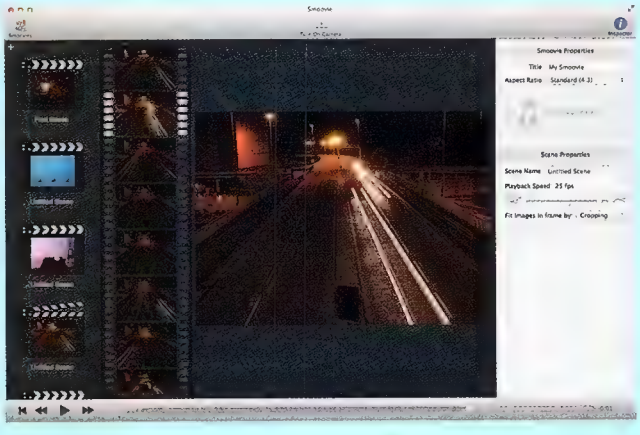
Final Cut Pro X was poorly received in 2011, with many essential features from Final Cut 7 missing. Since then, a string of updates has reinstated features.

The latest release, 10.1, can now exploit the Mac Pro's dual-GPU configuration, preview vision on an external 4K monitor, and titles and effects are designed for that resolution. But it also continues the steady flow of feature enhancements to get the job done on any Mac. Libraries change the workflow for the better. Projects and events are browsed in a single pane — libraries contain events, which contain clips and projects. Like their counterparts in Aperture and iMovie, libraries look like a single file in OS X's Finder, but you work with them like documents. They're a natural way to separate work for clients and productions — just like Final Cut 7's project files were. A library can contain more than timelines and links to media too; your media can be stored in them, along with render files, analyses of camera shake and other generated files. This siloing of your work is even easier to manage than Final Cut 7's system folders.

Archiving events and projects is done by copying them and the original media into a new library. Ensuring referenced media is copied into the archive does however make this a two-step process using separate menu items. Clips can be retimed to an exact duration, and more or less of the source can be used to avoid ripples in the timeline. Complementary to this is a 'Retime to Fit' option when replacing something with a new clip. Moving, copying and pasting keyframes in the timeline is trivial, but observing parameters remains awkward due to the Inspector being crammed into a small height. Motion's full-height sidebar is better. However, trying out alternative edits is simpler with snapshots, which cut out the media management questions asked by the Duplicate Project feature. Many editors don't need to use custom frame sizes, but this capability makes it easier to edit for portrait displays. Three years of major additions and tweaks make Final Cut Pro X 10.1 what it perhaps should have been on first release. Once you adapt to its presentation and shortcuts, its workflow and performance are a delight. **Alan Stonebridge**

Smoovie 2

$41.99 | OPEN PLANET SOFTWARE | SMOOVIE.COM

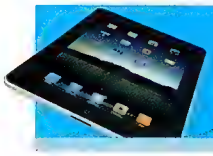


Smoovie 2 is a simple app that allows you to create stop-motion animations. Smoovie's clean and intuitive layout makes the process easy; even kids will quickly be making little animations about terrifying plasticine monsters. One handy feature in Smoovie is Onion Skinning, which lets you see a ghost of your previously-captured image on top of your live video, so you can keep the movement in your animation fluid. Frame management is likewise easy to manage; click and drag in the column of images to rearrange existing frames. When you're ready, tap the space bar to capture another image.

To play back your film, you have to temporarily disconnect from your camera with a button at the top of the window. This feels a tad clunky but it's not a big problem.

There's a selection of effects you can add to your video too. Many of these won't really do much, but a few are fun and useful, such as the chroma key for masking out and replacing the background of your image with a different one. This assumes that you've used a blue or green background, although a slider lets you pick the level of show-through. The exposure effect is also great for brightening up your image.

The software doesn't currently support DSLRs, so you're limited to a webcam, camcorder or iSight camera. This means Smoovie isn't really suitable for professional work, but overall it does make creating animations quick, easy, and — most importantly — fun. **Max Martin**



App Store » iOS APPS

KORG Gadget

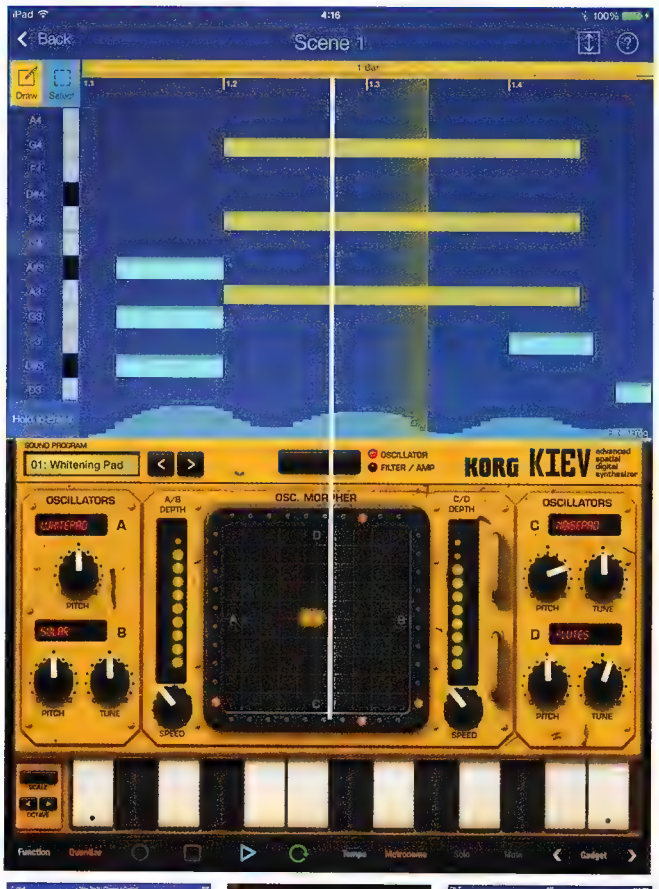
A treasure trove of vintage music gear that never existed.

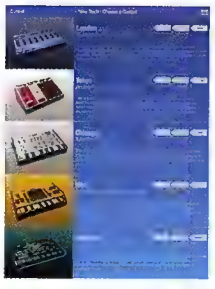
$40.99 | KORG INC. | TINYURL.COM/NRPJ8NF

Cast an eye over the promotional material for KORG's stunning new Gadget app and you might notice a little smoke and mirrors going on. Promo photographs show off 15 colourful and decidedly retro-looking synthesizers arranged beside an iPad, but in actual fact... none of them are real. The so-called 'Gadgets' included with KORG's new music maker for iPad might sound like the real deal – and they are modelled on classic synths – but the faux plastic hardware is just a marketing tease, albeit one that's as convincing visually as the synthesizers are sonically.

Gadget gives you these 15 different virtual synths and an intuitive touch-based sequencer that makes it extremely easy to create music in next to no time at all. There's an astounding variety of sound-making possible here: set down a drumbeat (three of the synths are drum machines), then just jam along or compose a melody to go with it. Maybe start with a fat bass, throw a lead on top, then fill out the sound with some pads in the background. On the most recent iPad (Air), you can have up to 20 or so Gadgets running at the same time: a veritable electronica orchestra. Memory constraints will limit you to just five or six simultaneous tracks on an older tablet like the iPad 2, but that's still enough for a rich groove.

Each Gadget comes with a distinctive personality and includes dozens of preset voices plus a host of manual effects controls, meaning you'll likely never run out of creative options. Musical knowledge isn't essential (but it certainly will help). Gadget is designed for 'electronic' music – it's not suited for classical, country, rock or folk sounds – but if you ever wanted to be the next Daft Punk, this really wouldn't be a bad place to start.

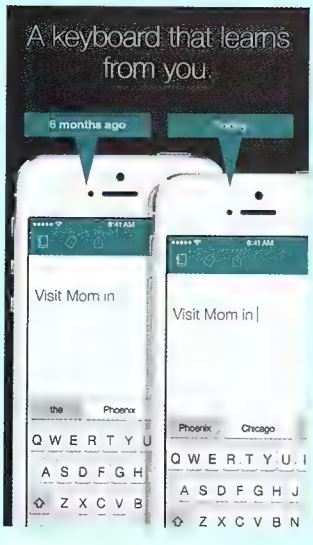




SwiftKey Note

FREE | SWIFTKEY | TINYURL.COM/QJ2VHJQ

I really hate typing on my iPhone; I'm mistake-prone, which makes writing even short messages an exercise in frustration. In that regard, Android's expansive library of keyboard apps mark one clear benefit of Google's OS. There's no such equivalent in iOS, since Apple keeps access to the keyboard software tightly locked down. (Apple may have pioneered the touchscreen smartphone, but its un-evolved, standstill virtual keyboard is just plain dumb.) But at least now there's an *inkling* of change. SwiftKey Note, from the makers of one of Android's pioneering keyboard apps, brings you smart, predictive text input in an otherwise simple note-taking app. You won't be able to use this keyboard in any other iOS apps — it only appears in SwiftKey Note — but if you're at all butter fingers, this could well become your go-to mobile writing app. Any hey: there's always copy and paste, right? There's no gestural support at present (ie. no 'Swyping') and it's portrait only, but SwiftKey Note is quick, easy to use, includes optional Evernote syncing and is totally free.



Dungeon Keeper

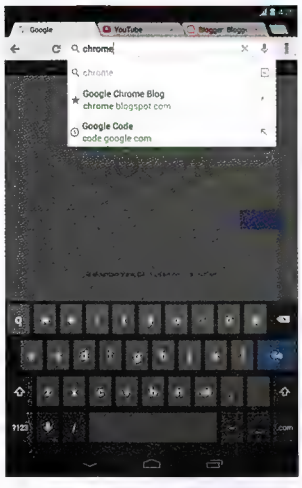
A hoped-for reboot whips up a storm of controversy.

FREE (WITH IAP) | EA | TINYURL.COM/LBCSMGU

In certain quarters of the internet it's a hotly debated topic: are we facing a crisis in gaming? Critics contend that increasingly popular in-app purchases (IAPs), particularly in mobile games, have destroyed the notion of 'pure' gameplay: IAPs, they say, skew games, lock games, delay games and break games – replacing them with something tantamount to a dressed-up parking meter, where payment equals progress. In the very worst circumstances, the implementation can effectively drain all enjoyment from something that's supposed to be, you know... fun?

Such is the case with EA's now infamous reboot of *Dungeon Keeper*. The '90s original is considered a classic PC strategy title, and anticipation was initially high when word spread it was being ported to Android and iOS. And then reality kicked in; this isn't the original game many knew and loved, but a thinly disguised attempt to shovel IAPs. Famed game creator, Peter Molyneux, designer of the original title, has himself dubbed the remake "ridiculous". The new *DK*'s bawdy tutorial even jokingly references the controversy surrounding IAPs, at the very same time as it 'teaches' you how to spend gems in the game to negate delay timers!

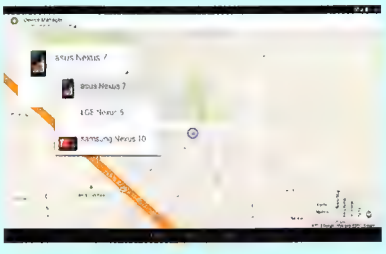
And don't let the high ratings on Google Play and the App Store fool you, either. It seems it isn't just the game itself that's skewed: to top it all off, EA has jury-rigged the app's rating system by misdirecting discriminating reviewers away from the app portals via a dedicated internal 'feedback' form for anyone not inclined to lavish a 5-star rating on this cynical effort. Shameful stuff, positively devilish!



Chrome

FREE | GOOGLE | TINYURL.COM/6LTRDOQ

It's a fair bet that nearly every Android user reading this already has Chrome installed on their device(s), but it's worth drawing attention to one of the browser's latest features. Chrome on mobile now supports data compression as an optional setting. According to Google, when data compression is enabled it can cut down on your data usage when browsing by *up to 50%* — a huge factor, especially if you find you're often nearing (or exceeding!) your mobile data quota. The Opera-like feature relies on Google's servers to do more heavy lifting at their end, with an added benefit being a Safe Browsing mode that quarantines malicious sites. To enable data compression, update Chrome and visit 'Settings > Bandwidth management > Reduce data usage > On'. It's also available in the iOS app.



Android Device Manager

FREE | GOOGLE | TINYURL.COM/QY5V5C4

Another significant home-baked Google effort, Android Device Manager has actually been around for a while now as a web service, but the Android app itself only emerged recently. Despite the dud name this is a must-have tool that helps you locate other Android devices if they go missing, with lock and remote wipe options (if you suspect they've been stolen). Android Device Manager might be playing catch-up with Apple's Find My iPhone... but better late than never.

Windows Store » WIN PHONE 8

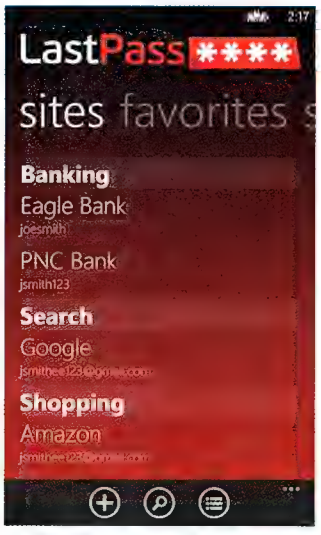
LastPass

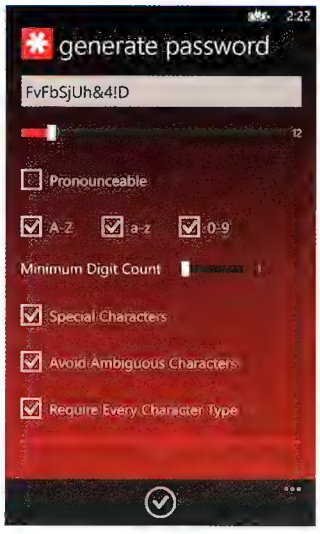
Peace of mind... for a small monthly fee.

FREE TRIAL / $12 ANNUAL SUBSCRIPTION | LASTPASS | TINYURL.COM/NA9K4UC

Of all the various commercial password managers available, we always seem to come back to LastPass. It's slick, simple to use and works effortlessly with virtually every popular desktop browser, meaning it's a convenient way to manage login security on your PC, and especially when you're using multiple machines.

Of course, like many of its competitors, LastPass comes with a significant restriction: it's free on desktop, but accessing your password vault on your mobile will cost you (a $12 annual subscription in LastPass's case). Still, it's not at all a bad investment for Windows Phone users. The WP version receives regular updates, and the convenience cost of just $1 per month to have secure login access on the go is so slight it's virtually free.





One limitation is the app requires you to use its own built-in browser (it can't feed passwords externally to your other software), which might not suit everybody. Give the free 14-day trial a go and decide for yourself.

Final Fantasy III

$16.99 | SQUARE ENIX | TINYURL.COM/LDV4EUR

It doesn't matter what mobile app store you're on, when it comes to the gaming section most releases seem to hover around three distinct pricing tiers. First, you've got your impulse buys: they're either free or 99 cents (sometimes stretching as high as $2). Second, your 'premium' games that target the $5-$10 price point, the higher asking price usually signalling you're in for some superior mobile playtime. Then, you've got your third tier: Square Enix. The Japanese developer that mainly specialises in Japanese RPGs (often referred to as JPRGs) which is particularly famous for its mobile ports of the classic *Final Fantasy* series. Square Enix prices its titles with seemingly no regard whatsoever for the otherwise herd-like economics of the app stores. At launch Square Enix/*Final Fantasy* titles will set you back a price in the high teens, and the company's only occasional sales buck the common trend too, never dropping more than a few dollars off the full RRP. But retro adventure lovers don't mind, as each Square Enix reboot — like *FF III* here — packs an epic pixellated quest of truly humongous proportions (and bear in mind the console originals cost an awful lot more the first time around).

poki
home
ITEMS
Samsung SSD 840 EVO mSATA (120GB, 250GB, 500GB & 1TB)
Microsoft sold twice as many Windows Phones the week
Losing Aaron
@font-face web font research - Google Drive
Bind/README.md at master praeclarum/Bind · GitHub

Poki

$2.49 | CEE | TINYURL.COM/P2JGCEK

While more and more official apps are making their way to Windows Phone, a number of pivotal services remain in absence, with third-party efforts being the closest you'll get to the real thing. Personally speaking, it doesn't get much more pivotal for us than read-it-later service Pocket, which helps you snavel practically any digital content you see online to enjoy later on (even if you're offline). Poki is a svelte Pocket client with very Metro stylings and a cute little twist of its own: you get achievements for reading the articles you've saved. Free trial available.

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WATCH_DOGS

ASSASSIN'S CREED IV BLACK FLAG

BATMAN ARKHAM ORIGINS

CALL OF DUTY GHOSTS

NVIDIA GEFORCE GTX

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NVIDIA ORIGIN HIGH PERFORMANCE PCS GIGABYTE™

Over the last three decades *APC* has had many editors leading the charge. We tracked some of them down to hear about technology and their time with *APC*.

HOW DID YOU GET INVOLVED WITH COMPUTING, AND WHAT WAS YOUR FIRST PC?

I got involved when I finished my cadetship at the Sydney Morning Herald way back in the late 80s. I was the only cadet who volunteered for the technology pages, my fellow cadets thought I was a bit strange. My first PC was an Acer 286 — I still remember its start up sound like it was yesterday.
Tony Sarno (2004-2013)

My Dad used to take me to his work sometimes on the weekends. They had Wang VS Minicomputers. I'd play *Martians* and *Star Trek* on the terminals, and curiosity quickly led me to figuring out how the games worked. It didn't take me long to get hooked on programming, and from then on I was at a computer any chance I could get. Our first home personal computer was an Atari 400. I lived on that thing, hunched over an old portable TV sitting inches from my nose. I used to type out the program listings from the back of APC!
Jeremy White (1994-1998)

In the early 80s I was a contributor to a few Australian radio-communications mags. A fellow contrib had set up his own BBS, and we all immediately saw how this could revolutionise the way we worked. So I read some computer magazines to learn about PCs (that's how I discovered *APC*, by the way!) and ended up buying an Amstrad PPC640, which was a 'portable' DOS 3.3 machine with a tiny mono LCD screen, twin 3.5in floppy drives and an in-built 2400bps modem.
David Flynn (2001-2004)

400TH ISSUE! & COUNTING

APC PUBLISHES ITS 400TH ISSUE THIS MONTH AND TO CELEBRATE, ASHTON MILLS TAKES A LOOK AT WHERE IT ALL BEGAN AND DIGS UP HIGHLIGHTS FROM THE MAG'S FIRST THREE DECADES.

Well, how time flies? You're reading the 400th issue of *APC*, Australia's first and oldest technology magazine. An endeavour that has been charting computing now for thirty-four years – so long that there are *APC* readers whose children have since picked up the magazine and become *APC* readers themselves.

And what a journey it's been.

Much like the technology we report on, *APC* has itself changed and evolved over the decades. From humble beginnings in a bedroom (not far off from the *garage* synonymous for start-ups), printed in black and white back in 1980, to the triumvirate of magazine, bundled-in disc, and web site that still leads technology publishing in Australia today.

And what was once a niche interest – those new-fangled 'microcomputers' that only the very nerdy fringe would ever dream of playing with – has blossomed into an integral part of our every day lives. You don't have to be technical, or a computer geek: everyone from children to centenarians are now plugged in through tablets and smartphones and a myriad of gadgets. In fact, there are few aspects of modern life that aren't governed – or at least influenced – by computing. We remain connected, integrated, and in debt to technology, be it making a phone call, driving a car, or simply reading the news. Computers, now, are one with us.

And along the way *APC* was there with the enthusiasts, the pioneers – people like you – sharing and exploring the new technologies and finding their full potential.

So it's with fondness that, this month, we take a look back on 400 issues of *APC*. Not just a magazine, not just a source of information, but a pillar of the industry, a beacon of possibility, and a shared journey of the power of technology and its impact on our lives. It is *amazing*, when you think about it.

We could fill volumes looking back at the past, so here's just some of the highlights. A reminder of where we've come from, and where we are going.

Here's to the 500th issue. May it be holographic!

ANY PARTICULAR ISSUE OF APC THAT STANDS OUT FOR YOU WHILE YOU WERE THERE?

My absolute favourite was in late 2012 when we assessed Windows 8 in the labs and seriously questioned it, labelling the new Metro interface a fail. At a time when tech bloggers and endless Microsoft evangelists fawned over the new OS, we called it as we saw it. So just as Windows 8 was released commercially and Microsoft ads were all over the TV, *APC* was the lone dissenter saying Windows 8 was going to be another Vista.
Tony Sarno (2004-2013)

Some of the issues that sold like hot cakes because of the excitement around the technology, particularly when we launched our cross media strategy of print, web and CD working together, or when we switched to 100% Australian content from licensing overseas material, both of which were real innovations at the time. Some are favourites because of the work involved, such as when we were testing hundreds of PCs after launching the biggest testing labs in the southern hemisphere. Some issues are personal favourites because of memories of our team and how close we all were — to me it felt like family and friends working crazy hours on something we loved.
Jeremy White (1994-1998)

I began on *APC* back in 1995, in the midst of one of our ludicrously ambitious hardware features: 100 PCs, comprehensively tested and individually reviewed. There were 386s, 486s and the crazy-fast super-scalar Pentium computers. The feature itself ran for more than 50 pages.
Nathan Taylor (2000)

BRAVE BEGINNINGS

Like all great innovations, *APC* began as an idea. In London, in fact, as Sean Howard walked along Tottenham Court Road and saw a Commodore PET (short for *Personal Electronic Transactor*). He was amazed to find a number of magazines catering to this 'microcomputer' trend in England, but could find none in Australia when he returned home.

While he was still on a break from studying to become a doctor at Melbourne University, he decided the lack of a local microcomputer magazine was something he wanted to change. He wrote to publishers around the world with microcomputing titles asking for help. Only one responded, and the reply was from the CEO himself, Felix Denis — an eccentric British publisher who today is worth north of $750 million for his publishing empire.

Mr Denis didn't just reply to Sean; he sent him a box of every issue of *Personal Computer World* ever published, along with a simple note: "Don't wait for a contract. Use any and all of the material in these magazines. Start publishing as quickly as you can before competition grabs the market. You and I can sort a licence arrangement later."

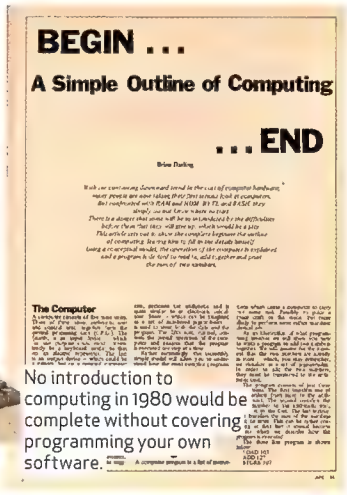
And so in May 1980, *Australian Personal Computer* magazine was born. A year later, producing *APC* as a hobby and with the magazine not yet turning a profit, Sean went back to medical school — but soon changed his mind. His heart was now with publishing, and returning his focus back to Australia's first computing publication, *APC* finally begun to turn a profit during its second year.

Sean Howard founded *APC* in May 1980 before going on to launch OzEmail, one of Australia's most iconic ISPs.

Three years later, in 1984, Sean was approached by Kerry Packer's Australian Consolidated Press. When asked how much he wanted for *APC*, and its then sister publication *Australian Business Computer*, Sean named his price. Kerry Packer shook his head and said (in slightly more colourful manner than we can print here), "Good God son, compared to you, Ned Kelly was a princess!"

But Sean knew the value of what he had been building, and negotiated a deal with Packer while maintaining part ownership. On his way out, Mr Packer offered a flight on his personal jet back to Melbourne, as you do. Sean declined, as his father was

The Compucolor II was the first product to be reviewed in *APC*, consisting of a very-thorough 6-page investigation of the PC.


BEGIN ...
A Simple Outline of Computing
... END
The Computer

No introduction to computing in 1980 would be complete without covering programming your own software.

There's never been a better time to buy an Apple II.
apple pascal
The lowest priced, highest powered Pascal system on the market.
Apple Language System NOW AVAILABLE @ ONLY $495.00*
THE GRAPHICS TABLET
Send now for our latest free book catalogue
FOR FURTHER DETAILS AND INFORMATION WRITE OR CALL IN
ComputerLand in Melbourne

Some *APC* readers will probably be shocked by the fact that the mag's first ad was for the Apple II, which appeared inside the front cover.

COMPUTER GAMES
Chess master, David Levy, begins a series of articles on the principles behind programming computers to play games.

The first issue's cover story was on programming your own games, written by British International Master of chess David Levy.

waiting for him outside.

After eight years at Consolidated Press, *APC* had developed into a world-leading computing title, with a range of spin-offs like *PC Week*, hardware and software buyer's guides, and running Australia's first computing trade shows. In order to privatise, however, Packer needed to acquire all of the computer publications group, so he bought out Sean's remaining share. When Sean asked what Kerry Packer wanted to do with OzEmail – a fledging project he had started – Packer replied "You can keep your [colourful expression] R&D division!" In order to solidify a contract, Sean offered Mr Packer $1 for OzEmail, and the latter agreed.

Seven years later in 1999, OzEmail was sold for $520 million.

Today Sean isn't involved in publishing or communications, but beyond using his wealth to make a difference with charities like Youth Insearch (and where he served as Chairman for ten years), he's still keenly interested in technology and has been funding development into modelling the mechanisms of human thought with Dr Scott Bolland at the University of Queensland. Sean calls Dr Bolland "one of the cleverest people I have ever met", working in a field that aims to empower computers with independent intelligence.

"When Sean asked what Kerry Packer wanted to do with OzEmail – he replied "You can keep your [colourful expression] R&D division!"

PROGRAMS

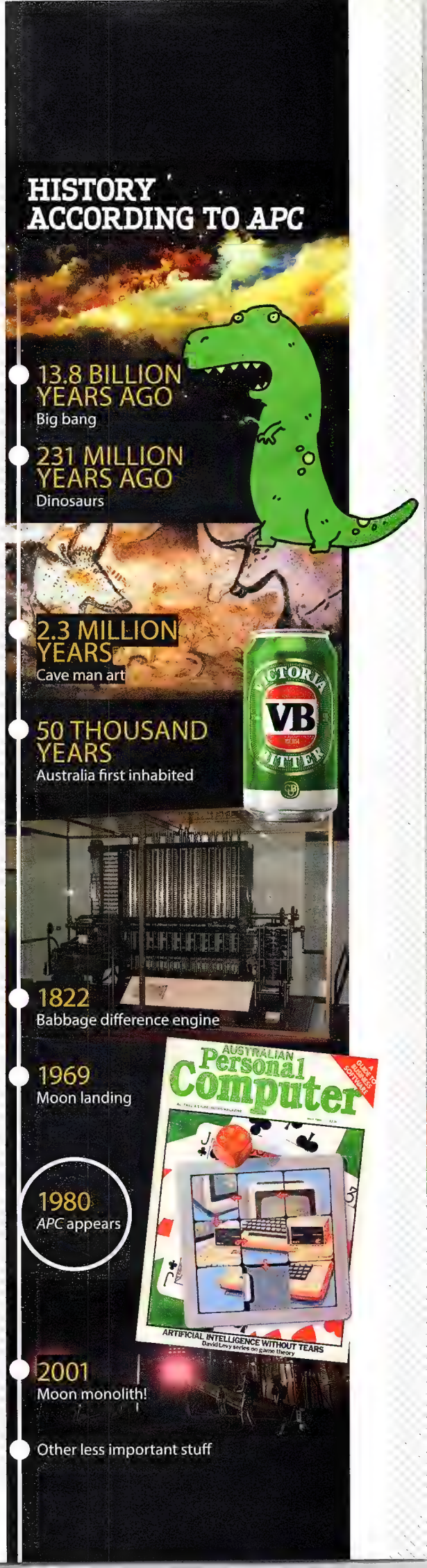
Submitting programs to APC

Having written and thoroughly tested your original program (be it an application, game, or useful subroutine) send it to us along with a suitable explanation. In order of preference we would like your programs submitted as a clear, dark listing on plain paper; on cassette or disc; clearly, accurately typed; or, clearly, accurately handwritten.

We pay the sender of any listing published at least $20, and often much more, depending on the size and quality of the contribution. If the program is too large or complex for the "Programs" section we will sometimes publish it as a feature in the magazine.

For the sake of balance, how about some of the owners of less popular machines pitching in as well? Post your submissions to APC Programs, PO Box 115, Carlton, Victoria, 3053. We look forward to hearing from you.

The back end of the first issue was (surprise!) dedicated to programming software, with readers invited to submit their own programs via mail ,Äî either typed or ,Äòaccurately handwritten,Âô.



Apple's original Macintosh was launched in 1984 and introduced many firsts, such as a mouse-driven virtual desktop environment (with icons to launch programs), digital fonts and more.

THE EVER-CHANGING PC

We take a decade-by-decade look at the big changes in tech through the eyes of *APC*, starting from 1980 and carrying through to the current day.

1980s

Ah the 80s – an era of fluro, big hair, pop music, and the inception of 'personal computing' as IBM releases the first PC. Microsoft, still a fledgling company, wrote PC-DOS for IBM's PC but retained the rights, a move that would come back to bite IBM just a few years later as Microsoft sells MS-DOS to PC clone makers.

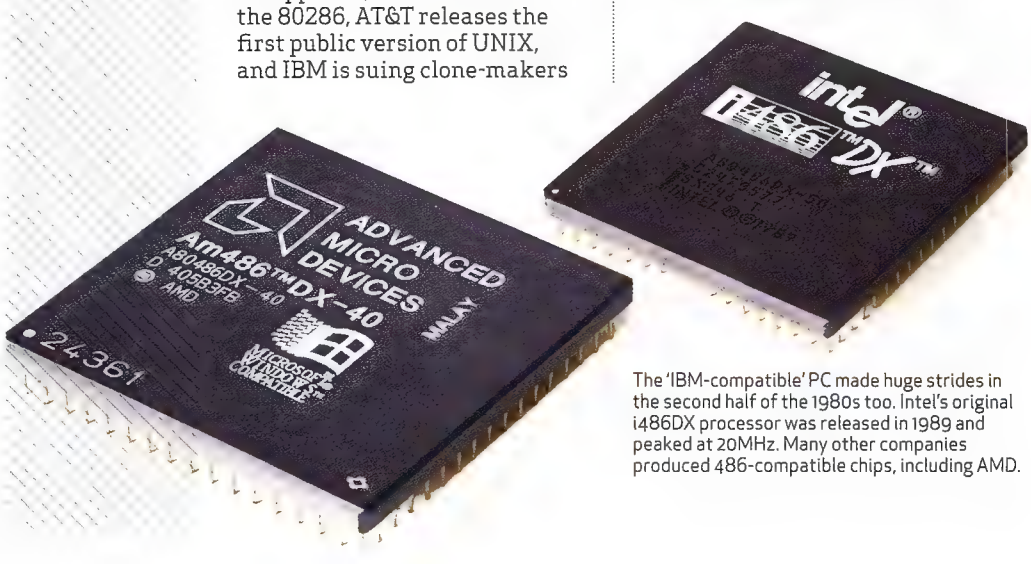
This is also the time of the Z80 processor by Zilog, which companies like Sinclair made popular with the ZX80 and later ZX81, ushering in affordable home computing (just a few hundred dollars in today's terms) for the geek masses.

By 1983 Apple has released its Apple IIe, Intel had launched the 80286, AT&T releases the first public version of UNIX, and IBM is suing clone-makers like Compaq for trying to copy its design.

The then academic and military network ARPANET – that would later give rise to the internet – standardised on TCP/IP for its network, which we still use today, while a company called Novell starts selling networking software NetWare.

And in the same year Commodore introduces the Commodore 64, a little beige box that would galvanise home computer gaming and popularise an industry that today makes more money than Hollywood.

By 1985 Microsoft announces Windows and Apple has launched the Macintosh, while Digital Research throws GEM into the



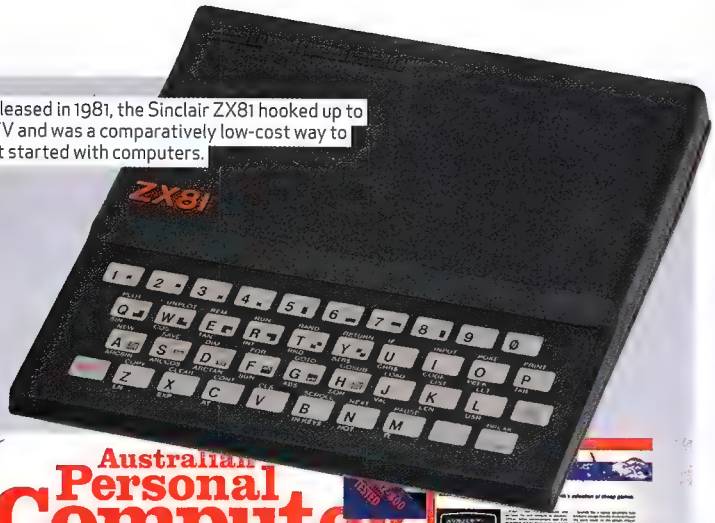
The 'IBM-compatible' PC made huge strides in the second half of the 1980s too. Intel's original i486DX processor was released in 1989 and peaked at 20MHz. Many other companies produced 486-compatible chips, including AMD.

WHAT WAS THE MOST SIGNIFICANT OR INFLUENTIAL DEVELOPMENT IN COMPUTING WHILE YOU EDITED *APC*?

Intel's launch of the Centrino in March 2003, and for more reasons than you might expect. Sure, it kick-started a notebook revolution, but Centrino had a farther-reaching impact than even Intel could have predicted. By putting Wi-Fi into notebooks, this in turn spurred a massive growth of public access hotspots and wireless networks. Even more seismic: Intel's Pentium M, which was the heart of the Centrino platform: it was designed from the ground up for efficiency, and turned out to be the prototype for today's Core processors. So we went from desktop chips ruling the roost to a future shaped by notebook processors.
David Flynn (2001-2004)

I started working at *PC Week* and *APC* in 1992, and by 1994 the rise of the consumer internet and the web were clear and came to dominate much of our coverage. This was also the period when GUIs and windowed operating systems took over from character based interfaces (amazingly Word Perfect 5.1 for DOS was still number one selling word processor in 1992). Steve Jobs returning to Apple (in hindsight) was clearly a watershed moment for the decade to follow.
Jeremy White (1994-1998)

The launch of the iPhone. It began the mass migration of consumers from overpowered and expensive PCs (and laptops) to lightweight mobile devices, which Apple then followed up with the iPad. The other major development was in the corporate space, where we saw the rise of cloud computing and cloud storage. These delivered computing power and services not previously possible on PCs.
Tony Sarno (2004-2013)



Released in 1981, the Sinclair ZX81 hooked up to a TV and was a comparatively low-cost way to get started with computers.

September 1985. The magazine is a mix of black and white and full colour, is machine-bound and reaches 200 pages. Sections like Screenplay and Workshop continue to this day, and complex programs with hundreds of lines are dutifully entered into computers by readers.

graphical user interface ring, later to be sued by Apple. Around the same time, luminary Steve Jobs is forced out of Apple and starts NeXT in response.

IBM innovates with the PC/AT, Sony and Phillips agree on the CD-ROM standard, and Richard Stallman starts a small thing called the GNU project.

Buoyed by its success with the C64, Commodore launches the Amiga, and while it would eventually succumb to the ubiquity of the PC clones, it catapulted multimedia into the spotlight later being used to produce special effects in TV and film.

It's not long before Intel releases the 80386, AMD gains popularity with its 80286 compatible, the concept of shareware takes hold and the first anti-virus programs hit the market.

By the end of the decade Intel has upped the ante with the 80486, IBM's OS/2 puts pressure on Microsoft, and Tim Berners-Lee proposes a networked hypertext system that later becomes the World Wide Web.

The iconic and exceedingly popular Commodore 64. An 8-bit PC that went on sale in 1982, it offered comparable specifications to the Apple II, but was significantly cheaper.

THEN vs NOW

How far has computing hardware come? Lets take a look at two snapshot machines from the 80s compared to today.

Yes, those units of measurement for the older machines are in 'MB', not a typo. Ignoring for a moment the effect of technology (CPU core architecture for example), and using the Compaq Deskpro 1 as a comparison — purely on numbers: CPU speeds are in the order of 500 times faster today; memory 25,000 times larger; disk storage 1 million times larger; and displayable colours 8 million times more. And at 1/5th of the price. Isn't progress great?

DESKTOP	1984 COMPAQ DESKPRO 1	2014 DELL XPS 8700
CPU	8MHz 8086	3.9GHz CORE I7-4770
MEMORY	640KB	16GB
DISK	20MB	2TB
SCREEN	MONOCHROME CGA	16.7 MILLION COLOUR FHD
WEIGHT	18KG	13.8KG
PRICE	$7,200	$1,500

PORTABLE	1984 IBM MODEL 70	2014 LENOVO X1 CARBON
CPU	20MHz 80386	3.9GHz CORE I5-4200U
MEMORY	4MB	4GB
DISK	60MB	128GB SSD
SCREEN	16-SHADE ORANGE VGA	16.7 MILLION COLOUR WQHD
WEIGHT	9KG	1.27KG
PRICE	$13,000	$2,049

WHAT WAS YOUR OWN FAVOURITE PRODUCT OR SERVICE AT THE TIME AND WHY?

A Palm Pilot. I was a Palm guy right from the start — I had one of the first model 1000s brought into the country — and in my *APC* days I was pocketing various members from the colour Palm m500 series. Little did I know that this was the zenith of the Palm experience...
David Flynn (2001-2004)

The internet dwarfs all else, along with the key services that today we take for granted. I can remember trying to convince management about the importance of the web, pushing them to connect to the internet and use email and collaboration tools for editorial.
Jeremy White (1994-1998)

When we got ISDN access for the internet. It was a huge change from the way things were done before. Instead of spending most of our time on the phone, we used email for everything. We could easily check facts online, and software became so much more accessible. It quickly became apparent that the internet would become the platform of the future.
Nathan Taylor (2000)

Strangely enough, despite the thousands of tech products that I had access to, I really loved two quite mundane things. One was solid-state drives. Every time one came into the labs, if the vendor didn't want it back, it would disappear into one of my computers. The other product that I couldn't do without was Dragon Naturally Speaking. I really hate typing and that software is now astonishingly accurate, enough to make me stop using keyboards, although constant talking to my PC used to drive my staff crazy!
Tony Sarno (2004-2013)

id Software's *Wolfenstein 3D* was the original first-person shooter and was followed up by the equally-successful *Doom* and *Quake* series.

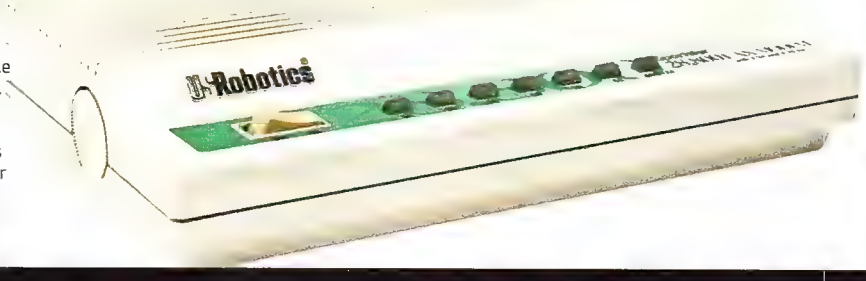
1990s

In the early 90s we saw the release of Windows 3.0 and Creative Labs building on the work of Adlib to create what would become synonymous with PC sound, the Sound Blaster. Pen-based computing takes hold, with Microsoft and GO Corporation releasing pen-enabled OSs, while Intel brings out the 486SX and AMD continues to eat away at the lower-end of the market with its 80386 compatible processors.

And a little known company called Id releases *Wolfenstein 3D*, the first game to provide free-look (on a horizontal plane) and birthing what we know today as the FPS genre for gaming.

In the same year a 21-year old student, Linus Torvalds, at the University of Helsinki makes a now famous post to Usenet about a small project he had started, and Linux version 0.01 was born.

It's not long before competition between former bedfellows Microsoft and IBM heats up with Windows 3.1 released in 1992 as well as OS/2 2.0. Intel continues to build on the x86 foundation with the 486DX2, marking a turning point for performance processors,



For most of us, getting online in the 90s involved a dial-up modem, like this 28.8Kbps U.S. Robotics model. Dial-up plateaued at 56Kbps and has remained there for over 15 years.

DID WE SAY THAT? YES WE DID!

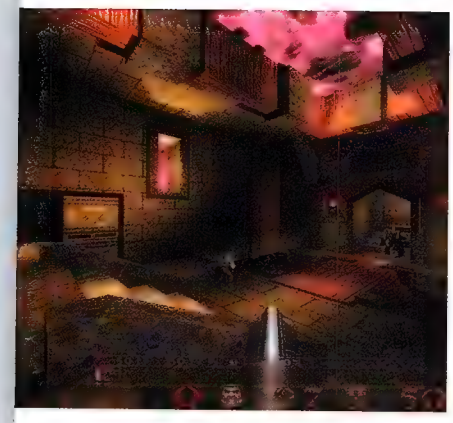
In previous anniversary issues, we've poked a bit of fun at ourselves by printing the predictions of *APC* journalists that would later turn out to be false. Reading them again in preparation for this issue, however, some of them have since eerily come true, or not far off the mark – showing that when it come to prescience, you may not always be right about when, but can still be right about what. Well, eventually.

"It's not exactly around the corner, but the day is not far off when my PC will recognise my face and call me by name."
John Sterlicchi, July 1989.

Today, Windows 8 and Android can log you in using facial recognition.

"Within a few years, mobile pen-based computers will be available in a wide range of sizes and configurations."
Robert Carr, February 1991.

Replace pen with touch, and you have the iPad and Android tablet revolution. Not to mention actual stylus-enabled products like the Samsung Galaxy Note.



Office 95, signalling the dominance of office suites.

Sony launches the Playstation console, and Amazon ignores the naysayers and starts selling books over the internet. Helping this along, 33.6Kbps modems hit the market delivering the net faster than ever before. And a little domain called Google.com is registered in 1997 by Larry Page and Sergey Brin.

The end of the decade saw Microsoft unleash NT 4.0, UNIX celebrating its 30th anniversary, Intel's launch of the Pentium III and Celeron processors, AMD's competitive K6 series, US Robotics' 56Kbps modems and the Pilot PDA with its handwriting-recognition software. Steve Jobs also returns to Apple to re-invent the company, resulting in the iconic iMac.

The Recording Industry Association of America (RIAA) sues Diamond over its Rio MP3 player, signalling a trend of old companies unprepared for the modern age. Microsoft is investigated by the US Federal Trade Commission for monopolistic and anti-competitive practices, resulting in one of the most high-profile technology cases in history.

and Cyrix joins the CPU rat-race with its own 486 compatible.

Apple, though having made a name for itself, releases the Newton PDA which soon becomes one of its more infamous failures.

By the mid-ninetines Intel's Pentium has arrived, Windows NT has established itself, Mosaic's 'browser' (later to become Netscape) is the standard interface to the web, Compaq becomes the world's largest PC vendor, Apple's Power Mac range hit the market, and the first doomsday predictions about Y2K enter the public mindset.

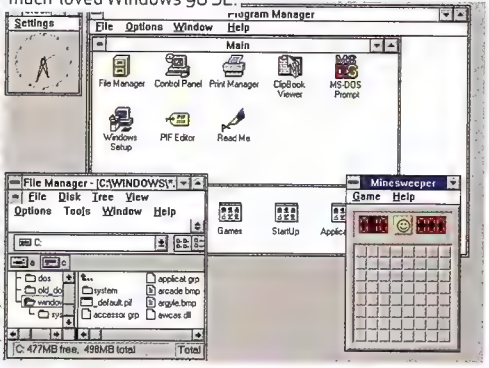
The biggest news, however, is Windows 95. This is followed by

In the days before the smartphone, if you wanted pocket-sized computing (and we use that term very loosely) a PDA was your only real option. This is Apple's Newton MessagePad 2000, released in 1998.

Australian Personal Computer
AUSTRALIA'S TOP SELLING COMPUTER MAGAZINE
Roll your own DOS extender
286 laptops: computing on the go

November 1990. Though there are competitors *APC* still leads the way, doing large bench-tests and covering every aspect of computing. Program scripts continue to feature, along with a multi-part pull-out manual that readers build over many issues.

Microsoft's Windows came to dominate computing in the 90s, starting with Windows 3.1 and ending with the much-loved Windows 98 SE.



"Has Microsoft lost its edge? Microsoft is running after everything it sees. There is no vision."
John Dvorak, May 1991.

The success of Windows XP and later Windows 7 certainly had Microsoft as top dog, but today it's a company competing to stay relevant in the face of mobile computing, having missed the boat on smartphones and tablets.

"Pen-LCD-Keyboard hybrids stand a good chance of becoming the personal computer of the future."
Bill Machrone, June 1991.

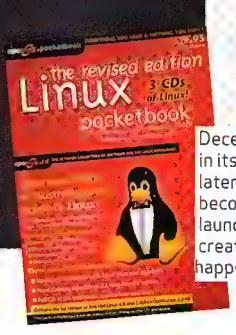
As it happens, the combination of LCD and keyboards found in laptops outsell desktops today. Still obsessed with pens though weren't they?

"Operating systems will probably be a flash in the pan. In the long run, users are more interested in applications."
Kester Cranswick, January 1993

Now this one is interesting. While the *APC* crowd may still obsess over operating systems, most everyone else — normal users in the market for iPhones, iPads and Android equivalents — don't. The OS is transparent — it really is all about the apps.

"The disk is dead, and the only question is: when do we bury it?"
Guy Kewney, June 1987

A tad early, but now that SSDs are mainstream, hard disks are gradually being phased out of consumer products.



December 1995. Leading the charge *APC* tests a massive 100 PCs in its world-leading labs, and the magazine fills 300 pages. A year later, one of the first cover CDs for any magazine in the world will become a regular feature, followed by another first with the launch of **www.apcmag.com**. And *The Linux Pocketbook* series creates a legion of new Linux users*. [*May not have actually happened; this Pocketbook was edited by Mr Mills himself. - Ed]

WHAT COMPUTERS AND GADGETS DO YOU USE TODAY?

I still have a top end gaming PC, plus a big 18-inch laptop, an ultrabook and a MacBook Air. But ironically-enough, I would say that 50% of my computing now is done on a mobile phone, 30% on a tablet, and 20% on PCs.

My main work environment is an iMac with second screen, an Acer PC with Ubuntu, MacBook Air, iPad Mini for running around, Kindle Paperwhite for reading, iPad for focused single task work (writing, research etc.), and various Android devices for testing and dev. A special shoutout to Evernote as my life saving external brain. Phil Libin I love you.

After using Windows since 2.1 and being a Windows specialist, I switched over to Apple quite some years ago and I really haven't looked back. I've got a MacBook Air and iPad Mini, and while I tried to give Android a great shot, I came back to the iPhone 5S. Geez, that tally makes me look like a real Apple fanboi... if somebody had read the tea leaves back when I was editing *APC* and delighted in reg-hacking Windows XP, there is no way I'd have believed them!

A Core i3-based Dell with a fanless AMD card — I don't like noisy PCs, and this is a silent workhorse. I love my Android tablet, a Motorola Zoom, and I game on just a console or two: a PS3, PS4 and Xbox One!

Intel's Pentium M, designed for notebooks, now underpins most of the company's desktop and mobile processors.

2000s

The new millennium didn't start off with a bang, with Y2K fears that the world would end passing uneventfully. AMD beats Intel to the punch by two days with the first 1GHz processor, while Microsoft launches Windows 2000 for businesses and Windows ME for home users, which dies a quick death until it's replaced by Windows XP in 2001.

Sony introduces the Playstation 2, ATI launches its Radeon line of GPUs, Dell becomes the largest PC manufacturer, and Bill Gates retires as CEO of Microsoft.

And that's just in the first year. 2001 sees its own milestones with Apple releasing the first iPod, changing the way we consume digital music, as well as the first version of Mac OS X, based on BSD, a form of UNIX. Microsoft reveals the XBox, alongside the news that Clippy will no longer be included in Office. The world rejoices.

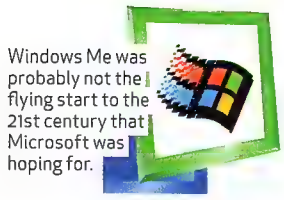
By the mid 00s we see Nvidia's GeForce FX proclaiming a 'dawn of cinematic computing', AMD's Athlon 64 as the first 64-bit consumer CPU and one of the most popular desktop chips of all time, and Intel's mobile-focused Pentium M which ultimately would underpin the Core design that's used by Intel's desktop CPUs today.

AMD was the first CPU maker to hit 1GHz and also the first to release 64-bit processors.

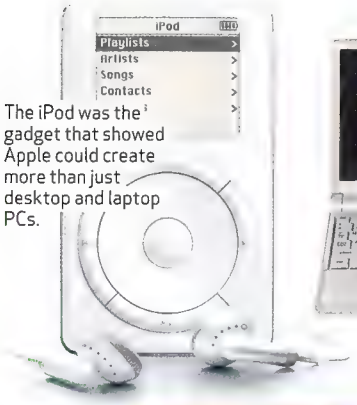
Along with this we saw YouTube founded, IBM announcing the end of life of OS/2, the launch of Mozilla Firefox 1.0, the first release of Ubuntu Linux, the unveiling of the Xbox 360, and Google introducing Gmail. But what made the news was the global DRAM price-fixing scam by major memory manufacturers that resulted in an epic fine of $300 million to Samsung for its part in the cartel, the second largest anti-trust fine in US history.

The latter half of the decade started slow with Apple's, Sony's PlayStation 3, Nintendo's Wii, and Intel starting a new trend with its Core branded CPUs. We also saw the introduction of Blu-ray, winning the next-gen

January 2010. With another masthead change *APC* continues to be a leading title, covering not just core computing but technology in all forms including smartphones and the mobile revolution. No longer just a niche magazine for 'micro computers', it's now read by people of all walks of life and levels of experience with computing.



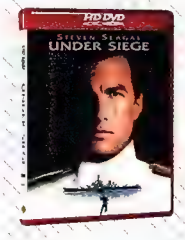
Windows Me was probably not the flying start to the 21st century that Microsoft was hoping for.



The iPod was the gadget that showed Apple could create more than just desktop and laptop PCs.

Netbooks were initially very popular due to their low prices and portability, but cramped keyboards and tiny screens led many to swear off the devices.

July 2005. Glossy, sleek, and with a masthead change *APC* packs in plenty of reviews and features as competition with the internet heats up, even as *APC* itself covers the changing role of the web in our lives.



With such hits as *Under Siege* available on HD-DVD, it's hard to believe that Blu-ray won the high-def format war.

optical storage war and putting HD-DVD to rest.

By 2007 Apple released the first iPhone and completely changed the smartphone market. We also saw ASUS launch the Eee PC and create a whole new category with netbooks, AMD unveiling its Phenom CPUs, solid-state drives becoming more affordable for the consumer market, and Amazon selling us the Kindle.

But the most noteworthy events were Microsoft's launch of Vista, perhaps the most reviled version of Windows in its history, and Google quietly letting Android out to play, now the world's most widely used smartphone operating system.

The end of the decade gave us Apple's vision of super-portable computing with the MacBook Air, the first commercially available Android phone with the HTC Dream, and Google hitting another home run with the Chrome browser, now the most widely-used browser in the world. There's a bit of a trend here with Google products.

And, while desperately trying to sweep Vista under the rug, Microsoft comes good with Windows 7. It's so good, that even with the release of Windows 8, most of the world's Windows users have stuck with it.

Technically scraping in on the other side of 2010, bringing us into the current decade, there are still some momentous moments. The aforementioned Windows 8 with Microsoft trying to evolve in a mobile world, Western-Digital subsidiary HGST announcing helium-filled hard drives pushing platter storage to 6TB, and perhaps the most important product release of all with Apple's iPad. Ushering in the age of the tablet, and with various sizes and flavours in both iOS and Android, the only product that's going to have as big an impact on the way we consume computing is perhaps Google's Glass – but at the time of writing, it's all too early to tell. We'll leave that for the next

> "By 2007 Apple released the first iPhone and completely changed the smartphone market."

Apple's MacBook Air was the original ultrabook, launched in 2008.

ANY ANECDOTES, TALES OF WORLD DOMINATION?

What's truly amazing about *APC* is that it's the last great PC magazine left standing. *APC* pre-dated both *PC World* and *PC Magazine* in the US and all other major tech mags that followed. Now virtually every other traditional PC print magazine from the early days of computing has folded, but *APC* still goes strong.
Tony Sarno (2004-2013)

Blind FRED (the Commodore Pet without a camera) could see that magazines faced a fraught future the day Tim Berners-Lee got the HTTP stack working. I love Pocket (the read it later app), and between it, Hacker News and interesting stuff in my social stream, the speed with which you find out about tech content is mind boggling. But in all the fractional consumption of the de-contextualised web much of the thematic coherency and community driven curation that magazines have always delivered has disappeared, and something has been lost in the shift to #Sharetroll buzzfeed headlines.
Jeremy White (1994-1998)

By its very definition a technology magazine is going to be cutting-edge, but *APC* has often been ahead of the times. You look at **Newswire.com.au**, which was a spin-off tech news site in the late 1990s, long before today's online tech sites and blogs. You look at *APC*'s collaborative Notes-based publishing system developed in-house under legendary editor Jed White, almost two decades ahead of 'Web 2.0 collaborative workgroup' platforms. I reckon every editor likes to think 'their' *APC* was something special, and all magazines are always a creature of their times — but honestly, looking at *APC* over the past few years through to today I don't think it's ever been better.
David Flynn (2001-2004)

Tell us! What was your first PC, what gadgets do you use today, and what do you think is the most important computing development in the last thirty years? Let us know by emailing us at apcmag@futurenet.com!

The Microbee was Australia's first locally-designed home computer.

Apparently, Apple had something to do with computers back then...

Many computer engineers can blame the Commodore 64 for giving them 'the bug'.

The tiny TRS-80 MC-10, sold in Australia for $99 with an 890KHz(!) clock.

The PCs of APC

From the Commodore 64 to 64-bit computing, Darren Yates' call-to-arms looks back at the glorious history that is personal computer hardware.

It's hard to imagine that when *APC* started, the IBM PC hadn't even been announced. We were still in those gloriously deluded days when computing was in the hands of enthusiasts furiously typing out BASIC code from magazine pages in impossibly small type, everything from games to home-loan amortisation, then saving them to cassette tape.

In 1980's Australia, Tandy Electronics ruled the roost with its TRS-80 models (Model I/II, CoCo, MC-10 and others) and by 1981, Commodore had launched the VIC-20 with its blazingly-quick 1.1MHz 6502 CPU. It wouldn't be until 1983 that the famed Commodore 64 began ingratiating itself onto TV RF sockets around Australia.

In fact, those early days were a boon for brands like Commodore and Tandy in the US, and Sinclair in the UK with its ZX81 and ZX Spectrum. Oh, and some US company called Apple claiming to have launched "the home computer revolution" — or something like that anyway.

But Australia was also a well-known hive of activity — we had everything from the build-it-yourself DREAM 6800, to the popular home-grown Microbee and even entrepreneur Dick Smith with his early VZ-200 and VZ-300 computers.

Looking back through the *APC* archives, one of the very first major reviews we published in 1980 was the potent TI-99/4 from Texas Instruments, running a fast 3MHz/16-bit TMS9900 CPU.

THE PC ARRIVES

But the arrival of the IBM PC in 1981 changed the hobbyist landscape forever and we all had to get used to new names like 'Intel' and 'DOS'. All of a sudden, computers were meant for serious work — with serious prices to match. Whereas the typical home computer sold for under $500 (and often for $99 when in the bargain bins), 'IBM-compatible' became the must-have feature, with prices for even relatively-basic models pushing $1,500, or six weeks' wages in 1981.

Intel's first-generation 8088 CPU with its 4.77MHz clock speed and 8-bit processing didn't stand out from a sea of competitors by that time, but it wouldn't take the future chip-giant long to try out-muscling the competition. Its first 16-bit CPU, the

BEST-VALUE $1,500 ALL-ROUNDER PCS — HOW THEY COMPARE

MODEL	J&W COMPUTERS $1,500 PC	PACSTAR GAMING/VIDEO EDITING PRO 2014	TI COMPUTERS TI DELUXE 270X	VENOM BLACKTOP COBRA PERFORMANCE
PRICE	$1,499	$1,499	$1,499	$1,499
SPECIFICATIONS				
PROCESSOR	INTEL CORE I5-4670K (42/42/41/40 TURBO)	INTEL CORE I7-4770 (3.4GHz)	INTEL CORE I5-4670K (OVERCLOCKED TO 4.4GHz)	INTEL CORE I5-4670 (3.4GHz)
MEMORY	16GB DDR3-1600	8GB DDR3-1600	8GB DDR3-1600	8GB DDR3-1866
MOTHERBOARD	ASUS B85M-G	GIGABYTE GA-H81M-D2V	ASUS Z87M-PLUS	INTEL B85 CHIPSET MAINBOARD
— CHIPSET	INTEL B85 EXPRESS	INTEL H81 EXPRESS	INTEL Z87 EXPRESS	AS ABOVE
GRAPHICS CARD	ASUS R9270X-DC2-2GD5	2GB GIGABYTE N760OC-2GD	2GB SAPPHIRE AMD 270X PCI-E3.0	2GB XFX R9 270X
— GPU	AMD RADEON R9 270X	NVIDIA GEFORCE GTX 760	AMD RADEON R9 270X	AMD RADEON R9 270X
STORAGE — SSD	120GB CORSAIR FORCE LS	120GB SAMSUNG 840 EVO	120GB KINGSTON SSD	120GB SAMSUNG 840 EVO
STORAGE — HDD	2TB SEAGATE SATA 6GBPS 7200RPM	2TB TOSHIBA DT01ACA200 7200RPM	2TB SEAGATE 7200RPM/SATA3	2TB SATA3 7200RPM
OPTICAL DRIVE	NONE	SAMSUNG SH-224DB DVD BURNER	BLU-RAY/DVD COMBO (SATA)	24X-SPEED SATA DVD BURNER
OS	MICROSOFT WINDOWS 8.1 (64-BIT)	MICROSOFT WINDOWS 8.1 (64-BIT)	MICROSOFT WINDOWS 8.1 (64-BIT)	MICROSOFT WINDOWS 8.1 (64-BIT)
LCD MONITOR	24-INCH ASUS VS247HR LED	23.6-INCH AOC E2450SWH LED	23.6-INCH AOC E2450SWH LED	24-INCH FULL HD LED

80286, arrived in 1982, which it licensed to a chip upstart called AMD. By 1985, the dual-family 80386SX (16-bit) and 80386DX (32-bit) processors appeared with clock rates eventually through the stratosphere to 40MHz.

By time of the release of the 80486 in 1989, there were already deep discounts available on older 8086 and 80286-based systems (which is how this author personally picked up his first PC, a new 16MHz 80286 'clone' for $1,100.)

The early 1990s saw 80386/486 systems trying out some new whiz-bang 'graphical user interface' concept called Windows or something and then, in 1993, Intel dropped a bombshell and the name we haven't been able to shake since – Pentium.

But technological development of the PC still progressed at a fairly pedestrian pace – clock speed gains were moderate and Intel wasn't hurried, releasing a new CPU family every four years or so. However, with the release of Windows 95 came the realisation amongst ordinary people that these computer things could actually be useful – and even fun.

> "With Windows 95 came the realisation these computer things could actually be fun."

CRANK IT UP!

The resulting five-year period between August 1995 and August 2000 saw not only the greatest advances in computing until that time, but the speed of those advances caught everyone by surprise. We began realising Windows needed memory and suddenly, RAM manufacturers began popping up everywhere. You saw systems arriving with up to a huge 128MB of RAM and poor Bill Gates begin copping flack for uttering the now-infamous 'Who needs more than 640KB of RAM?' (although he claims he never actually said it).

Between 1997 and 2000, AMD, which had long since lost those Intel licensing rights, took the fight right up to its rival and the two put on a good show as they raced each other to 1GHz – which AMD won by a day or two (and they even had to fight about that!). Not that CPUs were actually 'chips' at the time – they were humungous 'slot' abominations that looked like recycled Atari 2600 cartridges. Intel called its design 'Slot 1' and AMD the equally-imaginative 'Slot A'.

Thankfully, by the arrival of the Pentium 4 and Athlon XP in 2001, chipmakers had fab labs up to matching their dreams and processors were single (monolithic) designs once more.

But after all the fuss, the clock speed war ran out of puff by about 2004, when both sides realised how difficult it was getting transistors to switch on and off at much more than 3.6 billion times a second.

THE CALL TO ARMS!

As 2008 dawned, the PC was facing a perfect storm – Apple had given the world the iPhone; Microsoft had given the PC Windows Vista. 'Fortress PC' was further invaded by the Apple 'Trojan horse' of ARM Holdings, the designer of low-power CPUs to the stars, which were more power-efficient than anything else we'd seen before.

Suddenly, the hearts and minds of fickle everyday users (for let's just call a spade a shovel here) who thought computing was actually about them began to drift to promises of true 'personal computing'. Of all the nerve! Ancient tribal wars fought between Intel and AMD, Apple and Microsoft began to wane and die as a new light on the hill shone forth to captivate (almost) all who saw it – Google's Android.

But, dammit, this is no time for the next-generation of bearded PC enthusiasts to cry into their skim-lattes flicking their tiny coffee-splattered and splintered screens! The PC continues to not just survive the storms of Android and Windows 8, it thrives with lashings of new tech, from SSDs to hex and octo-core CPUs and graphics cards that can crack passwords in a heartbeat.

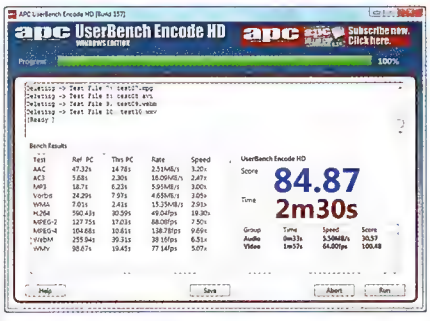
Just to prove that point, this month we've rounded up four of the latest PC systems. In fact, they're so new, we had them built especially for this issue. We gave a range of manufacturers a budget of $1,500, demands for an 'all rounder' PC and told them to go their hardest.

You might have been able to buy a twin-floppy driving IBM XT 'clone' back in mid-80s for $1,500, but you young-uns gently put down those tablets and phones for a second and we'll show you what a real $1,500 computer looks like!

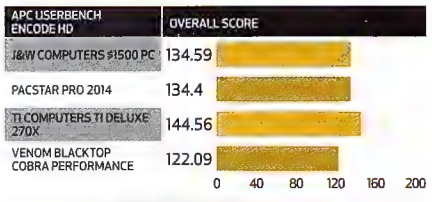
Intel's first 32-bit CPU, the 80386, topped 40MHz clock speed.

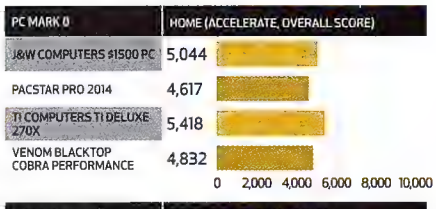
LABS BENCHMARK RESULTS

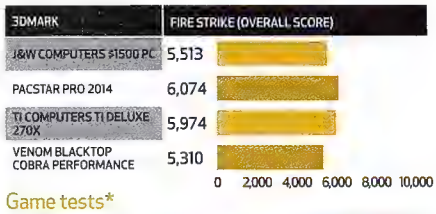
Want to compare these systems with your own? Download our exclusive *APC* UserBench Encode HD benchmark and give it a run. A score of 10.00 matches is referenced to a 2GHz Pentium 4 desktop PC, so if yours gets 50, it's five times faster. With all four systems scoring 122 or more, you'll get a good indication of how your current box stacks up. *APC* UserBench Encode HD comes with no warranty – use at your own risk – and can be downloaded from **apcmag.com/user bench-encode-hd-benchmark-software.htm**.



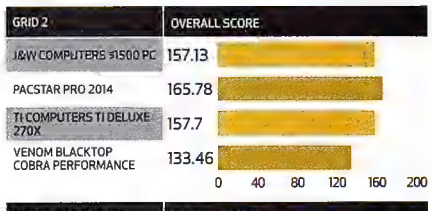
Performance Category

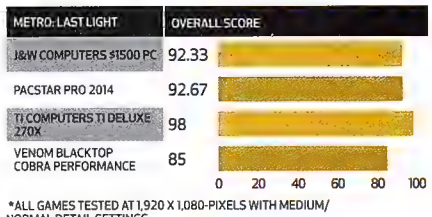

APC USERBENCH ENCODE HD
OVERALL SCORE
J&W COMPUTERS $1500 PC 134.59
PACSTAR PRO 2014 134.4
TI COMPUTERS TI DELUXE 270X 144.56
VENOM BLACKTOP COBRA PERFORMANCE 122.09
0 40 80 120 160 200


PC MARK 8
HOME (ACCELERATE, OVERALL SCORE)
J&W COMPUTERS $1500 PC 5,044
PACSTAR PRO 2014 4,617
TI COMPUTERS TI DELUXE 270X 5,418
VENOM BLACKTOP COBRA PERFORMANCE 4,832
0 2,000 4,000 6,000 8,000 10,000

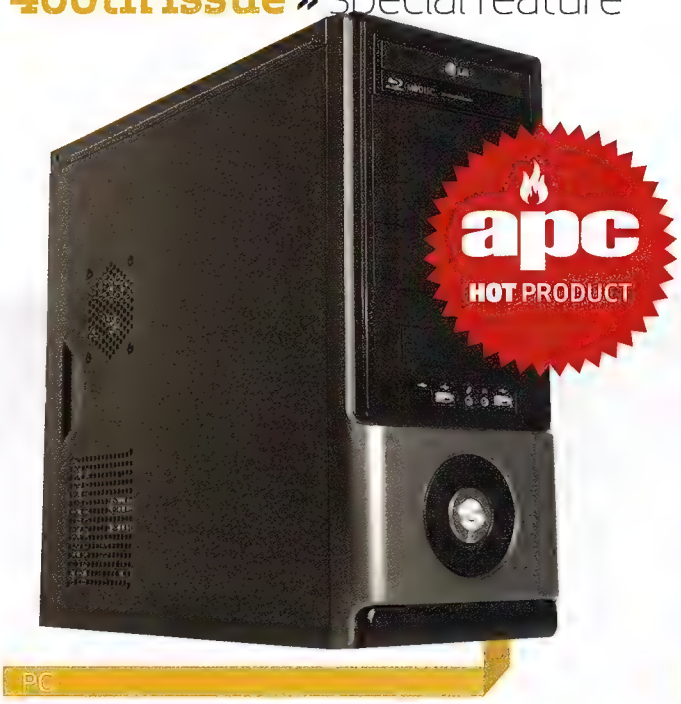

3DMARK
FIRE STRIKE (OVERALL SCORE)
J&W COMPUTERS $1500 PC 5,513
PACSTAR PRO 2014 6,074
TI COMPUTERS TI DELUXE 270X 5,974
VENOM BLACKTOP COBRA PERFORMANCE 5,310
0 2,000 4,000 6,000 8,000 10,000

Game tests*


GRID 2
OVERALL SCORE
J&W COMPUTERS $1500 PC 157.13
PACSTAR PRO 2014 165.78
TI COMPUTERS TI DELUXE 270X 157.7
VENOM BLACKTOP COBRA PERFORMANCE 133.46
0 40 80 120 160 200


METRO: LAST LIGHT
OVERALL SCORE
J&W COMPUTERS $1500 PC 92.33
PACSTAR PRO 2014 92.67
TI COMPUTERS TI DELUXE 270X 98
VENOM BLACKTOP COBRA PERFORMANCE 85
0 20 40 60 80 100

*ALL GAMES TESTED AT 1,920 X 1,080-PIXELS WITH MEDIUM/ NORMAL DETAIL SETTINGS.



$1,499 | WWW.TICOMPUTERS.COM.AU

TI COMPUTERS
TI DELUXE 270X

You don't always need a top-drawer chip to get top-drawer speed.

We liked all four of the systems we tested this month, but the TI Deluxe 270X from Sydney's TI Computers stood out just enough to pip the competition. Topping most of our performance tests didn't hurt, but TI was the only builder to deliver a Z87-chipset board. You don't need to worry about overclocking either – TI has that covered, cranking up the Core i5-4670K quad-core CPU to 4.4GHz, thanks to a Cooler Master Hyper TX3 CPU cooler. That showed in testing, with the TI Deluxe 270X blitzing the UserBench and PCMark/3DMark tests, even outscoring the Core i7-4770 chip inside the Pacstar entry. The Radeon R9 270X GPU is a popular choice at this price and the Sapphire model here acquitted itself well in games. It couldn't quite catch the GeForce GTX 760 inside the Pacstar system, but it was the closest to 100fps on *Metro: Last Light*. The 120GB SSD/2TB hard drive combo is popular everywhere it seems, but as we found, 120GB doesn't go as far as you think and it's arguably the first point you'll need to upgrade on all of the systems we saw. The Z87M-Plus is a decent board and TI Computers went the overclocking route in order to give you the pricier board without sacrificing performance – of course, you can always just crank up a 4770K if you have the cash. It's unusual to find a system builder selling overclocked systems, but TI Computers has been doing it for some time and we had no stability issues with this one at all during testing.

Verdict

It's overclocked and the only one here with a Z87 chipset board. Great value.

$1,499 | WWW.JW.COM.AU

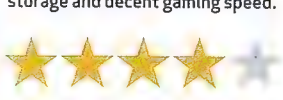
J&W COMPUTERS
$1500 PC

A Core i5-4670K turbo-clocked in a B85 board? Tell us more.

Local builder J&W Computers put together this largely ASUS-based system with an ASUS motherboard, graphics card and monitor in its $1,499 asking price. It was one of two systems to go with Intel's usually-business focussed B85 chipset. However, J&W has included the unlocked Core i5-4670K CPU which is cranked-up 42/42/41/40 Turbo multiplier settings to gain some extra speed (you can see the difference compared with the straight Core i5-4670 inside the Venom Blacktop Cobra). Corsair's popular 120GB Force LS isn't the fastest SSD going around, but it's faster than the 2TB Seagate hard drive, which still provides useful bulk-storage. ASUS's own R9270X-DC2 graphics card took the honours on *Tomb Raider* with a 141.5fps average frame rate and held its own across the other games tests. The inclusion of 16GB of RAM makes this ripe for a RAM drive setup, but we might've been tempted to drop 8GB and put the $100 towards a faster something-else. Still, this is a decent build and it demonstrates that the B85 chipset has definite (single card) gaming chops. For other pursuits, it managed to get the video encoding side of our UserBench Encode HD benchmark up over the 100fps mark, which is always a good sign.

Verdict

Good, solid performer with fast storage and decent gaming speed.



$1,499 | WWW.PACSTARCOMPUTER.COM.AU

PACSTAR GAMING/ VIDEO EDITING PRO 2014

Some unusual choices still net this one good overall performance.

Pacstar gave the roundup a real shake with this 'Gaming/Video Editing Pro 2014' machine. It's a build with some unusual features, but the end result is some excellent performance that anyone'd be happy with. Going straight to a stock Core i7-4770 is unusual, but so is the choice of board – Gigabyte's entry-level H81M-D2V. While it matched the other three systems for storage with its 120GB SSD/ 2TB HDD combo, the choice of Toshiba's new DT01ACA200 3.5-inch drive is also out of the box. This one also had the only Nvidia card we saw – a Gigabyte-branded GeForce GTX 760. It handled the 3DMark tests quite comfortably and took line-honours on the *Bioshock Infinite* and *GRID 2* benchmarks, however the whole proved to be just slightly less than the sum of its parts with sluggish PCMark 8 scores. That said, its UserBench Encode and gaming scores were enough to convince us that it can still do the job. The Core i7-4770 delivers eight HyperThreaded processing engines, but the benchmark results show little obvious benefit against the cheaper i5-4670K option. AOC is a popular monitor choice amongst system builders for its value for money, with Pacstar joining TI Computers in choosing the 23.6-inch e2450Swh LED monitor to round out this build. All up, this is a very decent, albeit somewhat slightly unusual, setup and definitely worth the look.

Verdict

Includes a Core i7-4770 CPU that made its GeForce GTX 760 GPU sing.

★★★★½

$1,499 | WWW.MLN.COM.AU

VENOM BLACKTOP COBRA PERFORMANCE

More gaming focused, but still fast enough for almost anything.

The team at Venom delivered this solid gaming build which, while not quite as fast as the three frontrunners, still delivered decent all-round performance. It starts with a stock Core i5-4670 on a B85-chipset board, powering AMD's Radeon R9 270X graphics engine. Venom chose the same Samsung 840 EVO SSD as Pacstar but, unusually, the Venom machine has DDR3-1866 RAM, whereas everyone else topped out at 1,600MHz memory. With a stock standard i5-4670 CPU, performance was down a little in this company, with its UserBench Encode HD result bringing up the field along with similar-level 3DMark scores. Its PCMark 8 results were on par, however. As a gaming centre, the XFX version of the R9 270X couldn't quite match the high notes that everyone else was reaching, with the exception of *Tomb Raider*, where it delivered an excellent 135.9fps average. Where Venom puts its money is in a solid full aluminium chassis and an equally impressive Seasonic 80 Plus PSU. Officially, the 450-watt PSU used here is below AMD's 500-watt requirement for an R9 270X setup, but the more important factor seems to be the GPU's 12VDC/30-amp rail current capacity requirement, which Seasonic's 450-watt 80 Plus Gold rated PSUs appear to deliver (37A). Either way, this box never skipped a beat during testing and is nicely put together. ■

Verdict

A nicely built, game-ready box just a little down on speed in this group.

★★★★½

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ULTIMATE UPGRADES

SPEED UP YOUR RIG!

OUR EXPERTS GUIDE YOU THROUGH THE UPGRADE MAZE TO HELP YOU LOCATE THE BEST-VALUE PC PARTS

Upgrading your PC can be a rather complex undertaking. If you find your performance lagging, even just figuring out exactly what part or parts need changing can sometimes require hours of investigation.

What's more, PC hardware has a habit of changing rather rapidly and there's no guarantee that the PC you built or bought a year ago will be compatible with the latest performance parts.

That's why this month, we've put together a concise (well, as concise as you can be with the multi-legged beast that is the modern PC) guide to upgrading the key components inside your – or your friends' or family members' – PCs.

If you've never upgraded a PC before, this guide will make the hardest part –figuring out what to buy and what the benefit is – a little easier.

However, even if you're a dedicated enthusiast with a dozen or more PC builds under your belt, we're hoping you'll find stacks of useful tidbits in here too. We can't be experts on every element of the PC; even the best of us have gaps in our knowledge. You can fill 'em up right here.

CPUs Page 56

MOTHERBOARDS Page 58

GRAPHICS CARDS Page 60

MEMORY Page 62

SSDs Page 63

POWER SUPPLIES Page 64

HARD DRIVES Page 65

MONITORS Page 66

UPGRADE best value

Some Ivy Bridge (3rd-gen) Intel chips are still available, but you'll need to hunt for them

MORE PROCESSING POWER

CPU upgrades are relatively easy to perform but difficult to plan. Darren Yates helps you navigate through the rocky path ahead.

No matter how much money you spend on a PC when it's new – performance will eventually drop below the point of no return. If the budget won't spring for a new PC, attention usually turns towards upgrading and the CPU as the most common place to start. It's not a bad one either, because the CPU will tell you sooner than any other component whether an upgrade is worth a go, or whether it's just worth letting go instead.

KNOW YOUR PC

Now, before you rip off the CPU's heatsink, it's a good idea to find out a bit more about your system – most importantly, the CPU you have and the motherboard it's plugged into. It's the socket type and chipset on the motherboard that'll tell you whether an upgrade is even possible. To make that easier, I've written a utility called *APC PC Auditor* that does the hard work for you. It details all of your PC's components in one simple list. You can grab it from **apcmag.com/pcauditor.htm**. (It requires Windows 8/7/Vista/XP – it is not currently compatible with Windows 8.1. While the app has been extensively tested, no warranty is supplied, so use of PC Auditor is at your own risk.)

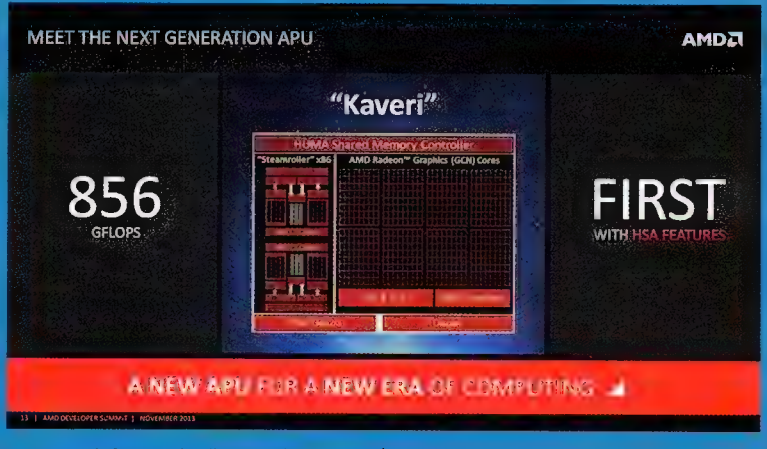
INTEL UPGRADE OPTIONS

Intel's CPU upgrade paths are up-and-down these days, due to regular CPU socket updates. Unless you have a relatively-recent 8-series chipset board, you won't have the LGA1150 socket required to handle any current fourth-generation Haswell CPU. However, the LGA1155 socket was used for the two Bridge series of chips – Sandy Bridge and Ivy Bridge – and it's still an available option.

These two generations of chips are for the most part interchangeable and can be used in most 6-series and 7-series motherboards. The important caveat is that you must check with your motherboard supplier for the minimum BIOS version required to enable CPU support. But it means that an old Sandy Bridge-grade Celeron box with an H61-chipset motherboard might actually be able to jump up to a quad-core Core i7-3770 chip.

Before you start celebrating, you'll need to make sure you can still find one of the latter, however. Most retailers still list Ivy Bridge CPUs, but few actually have stock on hand.

AMD's new Kaveri APU requires a new FM2+ socket. It's not for 'keep your motherboard' upgrades.



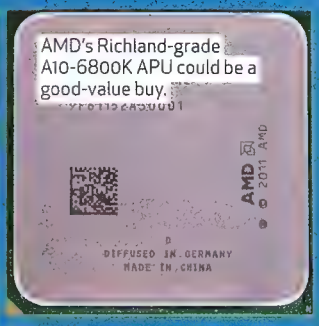
If you have a Z-series chipset board, the quad-core Core i5-3570K will be the best value option – it's close to the top-drawer Core i7-3770K in everything bar price (the caveat, again, could be finding one). If you have an H-series chipset motherboard, go for a standard non-K CPU, since H-boards can't overclock unlocked chips. As an example, see **www.gigabyte.com/support-downloads/cpu-support.aspx** for Gigabyte's H61-board CPU support list.

Looking to upgrade a pre-Sandy Bridge Intel system? Stop now. Check out RAM and storage upgrades, but leave the CPU alone – with no CPUs of this older vintage available, you'll need to make good with what you have.

AMD UPGRADE OPTIONS

Upgrade options for AMD systems, it has to be said, are a little chaotic. Starting at the

2nd-gen Sandy Bridge chips can run in many 3rd-gen Ivy Bridge boards — and vice versa.



AMD's Richland-grade A10-6800K APU could be a good-value buy.

Check your motherboard support before buying a Vishera-grade AMD FX chip.

beginning, the only CPUs AMD has available in retail at the moment are the AM3-socketed FX series and the FM2/2+ socketed A series.

The FX series is broken into two families – the underwhelming Bulldozer (FX-x100/x200) and improved Vishera/Piledriver (FX-x300/x350). Bulldozer CPUs need at least an AMD700-series chipset board, but be warned that support for Bulldozer across the AMD700 and AMD800-series board range isn't consistent. There's a smattering of entry-level Bulldozer chips left in retail, such as the quad-core FX-4130 for around $120. The best advice is to check your motherboard manufacturer's CPU support list for your board before you buy anything.

High-end Vishera/Piledriver support is similarly complex – for example, the new FX-9590 works in hardware revision 4.0 of Gigabyte's GA-990FXA-UD3, but not older version's (3.0 or 1.x), so again, check your board maker's CPU support list before you buy.

The A-series is easier to work out. All currently-available A-series chips need FM2-socketed boards. If you stick to Richland-series CPUs (A10-6800K and slower), you should find they work in any FM2 and FM2+ socketed board, but the brand-spanking-new Kaveri series, which includes the A10-7700K and A10-7850K, require equally-new FM2+ socketed boards. Again, check CPU support lists for your board before you do anything.

APC PC Auditor [Build 25]
apc
PC Auditor
General System Information
Processor: Intel(R) Core(TM) i5-2300 CPU @ 2.80GHz
Clock speed: 2794 MHz
Motherboard: Gigabyte H77M-D3H
BIOS: F6 - BIOS Date: 05/11/12 19:13:08 Ver: 04.06.05 (20120511)
System RAM: 8154 MB (1333 MHz)
Graphics card: NVIDIA GeForce GTS 450 No: 1
Hard drive(s): 1000GB WDC WD10EARS-00Y5B1 No: 2
CD drive(s): PIONEER DVD-RW DVR-220L No: 1
Sound card: NVIDIA High Definition Audio No: 6
Windows OS: Microsoft Windows 8 (64-bit)
Monitor: BenQ G2400W (Digital)
Graphics card specifications:
Model: NVIDIA GeForce GTS 450
RAM: 1073741824 bytes (1024MB)
Resolution: 1920x1200-pixels / 32-bit colour @ 59Hz
Max Refresh: 75Hz
Driver: nvd3dumx.dll,nvwgf2umx.dll,nvwgf2umx.dll,nvd3dum,nvwgf2
Version (Date): 9.18.13.3165 (20131023)
Video DAC: Integrated RAMDAC
Help
Copy
apc
Now on the iPad. Click here.
APC's free PC Auditor app lists your PC's components.

WHEN IS IT WORTH UPGRADING?

It's important to keep some perspective, even when a CPU upgrade is available. Not every upgrade makes financial sense and you need to keep track of where you started and where you're headed. For example, there's little point jumping up CPU generations if you're just jumping to the same family – an Ivy Bridge Core i5 is only 10% faster than an equivalent Sandy Bridge Core i5 and that bump mostly translates across Core i3 and i7 families as well.

Bottom line, make it a decent jump and upgrade across families – from i3 to i5 or i7, for example. Never just go 'like for like'.

That said, keep in mind that superseded CPU generations don't usually fall in price. For example, at the time of writing one retailer had the Core i7-3770K chip at $414, with the newer and slightly faster 4770K at $409. Another had the Core i5-4670K at $291, but the 3570K at $283.

A CPU-only upgrade is prized because it's quick, effective and relatively painless. But except in rare cases, you'll still end up with a superseded system – albeit a pleasantly faster one.

BEST UPGRADE OPTIONS — INTEL

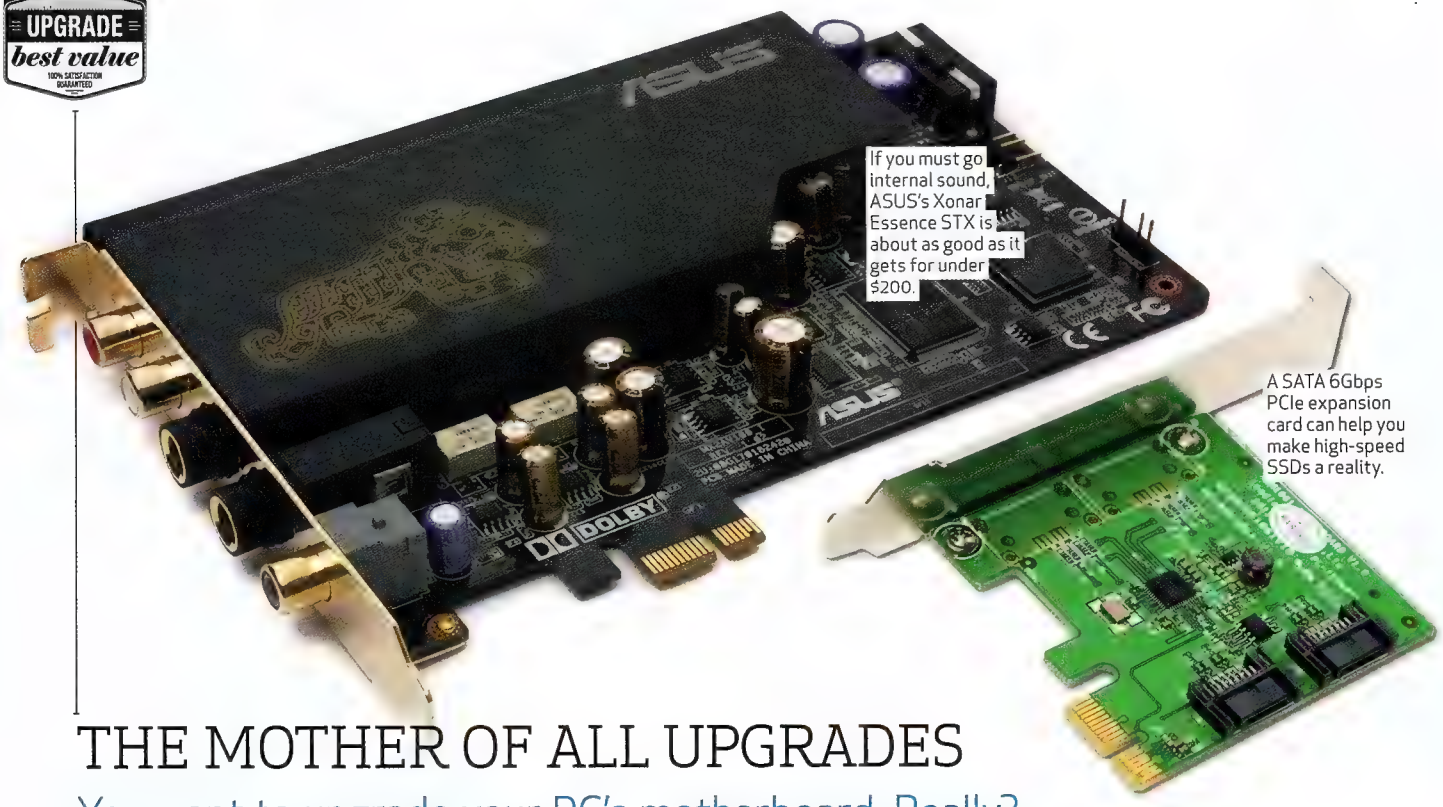
For dollar-proportional performance, Intel's Core i5 is the sweetspot – you get most of the performance of similar Core i7 chips but prices closer to Core i3. Roughly, it's about 80-90% of the performance for near two-thirds the cost. The bottom line: we'd choose a Core i5-3570K or 4670K (depending on your motherboard CPU socket) if you have a Z-series chipset, a Core i5 3570/4670 for everything else.

BEST UPGRADE OPTIONS — AMD

The general conclusion is that AMD's new FX-9370 Vishera chip is just an overclocked FX-8350, which itself is an overclocked FX-8320, so you may as well grab the cheaper FX-8320 and overclock it yourself. In the US, the price difference between the FX-8350 and FX-9370 is around $30, but in Australia, it seems closer to $150, which makes the cut-and-overclock idea far more appealing.

Kaveri is AMD's latest do-everything A-series APU, but early benchmarks seem to show the A10-7700K isn't matching the old Richland A10-6800K in raw CPU speed. A lower peak clock speed (4.1 vs 3.5GHz) won't help. What's more, AMD has dropped the price of the A10-6800K at retail to $10 less than the 7700K. The upside for Vishera is apparently considerably more GPU speed and reduced power consumption. We'll wait and let Vishera mature for a bit before deciding whether it's a worthy upgrade or not.

UPGRADE
best value
100% SATISFACTION GUARANTEED



If you must go internal sound, ASUS's Xonar Essence STX is about as good as it gets for under $200.

A SATA 6Gbps PCIe expansion card can help you make high-speed SSDs a reality.

THE MOTHER OF ALL UPGRADES

You want to upgrade your PC's motherboard. Really? Darren Yates contemplates the biggest upgrade you can perform.

Upgrading the motherboard really is the upgrade of last resort. It's the toughest one to pull off successfully because it requires the whole system to come apart. Not only that, there's every likelihood you'll also need to reinstall the OS. We've found it happens less often than it used to, but swapping a motherboard can be enough to cause a BSOD circle-loop or trip Windows' component change count limit, requiring you to reactivate your copy of the OS.

WHAT HAVE YOU GOT?

The main consideration with a motherboard upgrade is that it's not a huge leap further to build a new system instead. Looking at it purely from a hardware perspective, the basic upgrade rule we use is that if you're keeping your original motherboard, it's an upgrade. As soon as the motherboard goes, however, you're almost always talking about a new build, even if it's with mostly old components.

So again, you need to know your current CPU and research which current chipsets support it. But the one thing in your favour at this point is that it's generally easier for newer boards to support older CPUs (socket permitting) than the other way around. If you're keeping the chip and looking for a newer-generation board, your chances of coming out with a successful rebuild are better-than-average.

WHAT ARE YOU EXPECTING?

The other question to ask is what new features are you expecting? If it's a second PCIe graphics card slot, RAID, USB 3.0 or SATA 6Gbps, or even to enable overclocking of an unlocked CPU, those can be good reasons to upgrade. If it's just to get faster general performance and you're keeping the CPU, we have to ask — who put the bright idea into your head? The actual processing performance difference you'll see from a motherboard change for apps like video encoding is minimal. It's certainly not worth the angst you'll cop. A motherboard upgrade is about adding new peripheral features, nothing else — and even then, we'd think twice about the time and effort involved. That warning aside, let's take a look at what the options are.

UPGRADE OPTIONS — INTEL

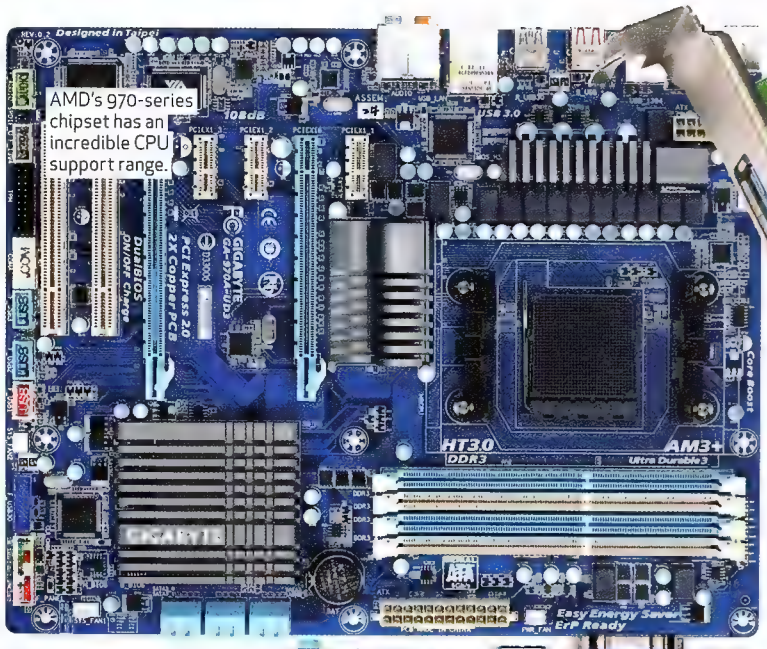
The only realistic hope you have is with Intel's LGA1155 socket that lasted across two CPU cycles — Sandy Bridge and Ivy Bridge. That means an older Sandy Bridge CPU can run on a newer Ivy Bridge-era motherboard (I have this by chance with a Sandy Bridge Core i5-2300 running on a Gigabyte Ivy Bridge H77 motherboard) and vice versa, with the usual 'check individual CPU/motherboard support and compatibility' caveats in place.

As for the features it lumps in, Intel's chipset families are easy to sort out — here's how it works: the Hx1 models (H61, H81) offer no RAID, no overclocking and usually only single-card gaming and minimal I/O ports; the Hx7 (H67, H77, H87) series adds in the dual-card (usually AMD) gaming and Intel RAID support, motherboard vendors also get more generous with more-exotic peripherals like S/PDIF; and Z-series boards throw in everything up to the kitchen sink. The other sometimes-forgotten option is the Bx5 chipset (B65, B75, B85), a kind-of Hx7 country-cousin that gains dual-card CrossFire gaming but not the RAID or overclocking.

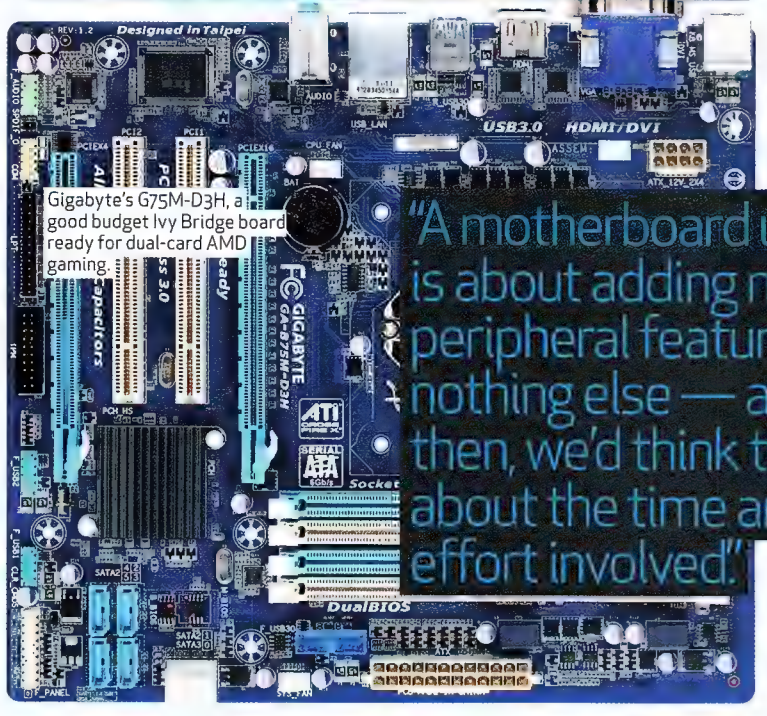
So simply, if you have a K-series CPU, find it a good home on a Z-series board. Otherwise and for all other non-K (ie. locked) chips, an H- or B-series option will do just fine. It depends on the external peripheral features you need — and what's available.

Intel wasn't overly generous with SATA 6Gbps ports in Series-6 and -7 boards, usually including just two, with the remaining SATA2. It was left to motherboard makers themselves to throw in extras and that's how you get the thousands of boards available — various combinations of SATA, USB 3.0, expansion card slots and so on.

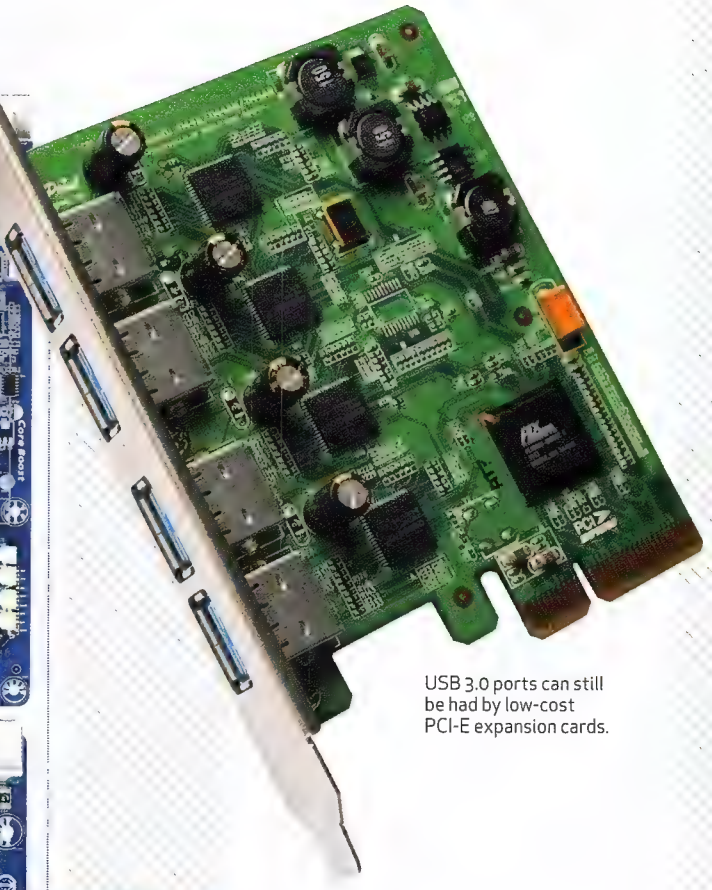
The way to pick a board is to start with your CPU and work out which chipset you need for the base core features. After that, hunt around for the right



AMD's 970-series chipset has an incredible CPU support range.



Gigabyte's G75M-D3H, a good budget Ivy Bridge board ready for dual-card AMD gaming.



USB 3.0 ports can still be had by low-cost PCI-E expansion cards.

"A motherboard upgrade is about adding new peripheral features, nothing else — and even then, we'd think twice about the time and effort involved."

combination of peripheral options that fits your budget. The good news is you'll still see occasional B75 and even H61-chipset boards typically well under $100, which should handle Sandy/Ivy Bridge-grade CPUs.

UPGRADE OPTIONS — AMD

Pick the right board and AMD's AM3+ socket CPU support is magic. For example, AMD's 970 chipset inside Gigabyte's GA-970A-UD3 can handle the eight-core Vishera-era FX-8350 or run down through Phenom II, Athlon II, all the way to the lowly single-core Sempron 145. AMD800-series boards can go from the same Sempron chip up to a Bulldozer FX-8150 CPU. So if you have an AM3-socket CPU, upgrading that chip to a newer board is less of an issue. You still must consult the board maker's CPU support list to find out the minimum BIOS version required, but otherwise, it's actually not too complicated.

With new Kaveri-class A-series chips bringing in a new FM2+ socket, it's likely the same will apply — older FM2 chips may end up running in newer FM2+ boards, but consult the motherboard makers web site to make sure.

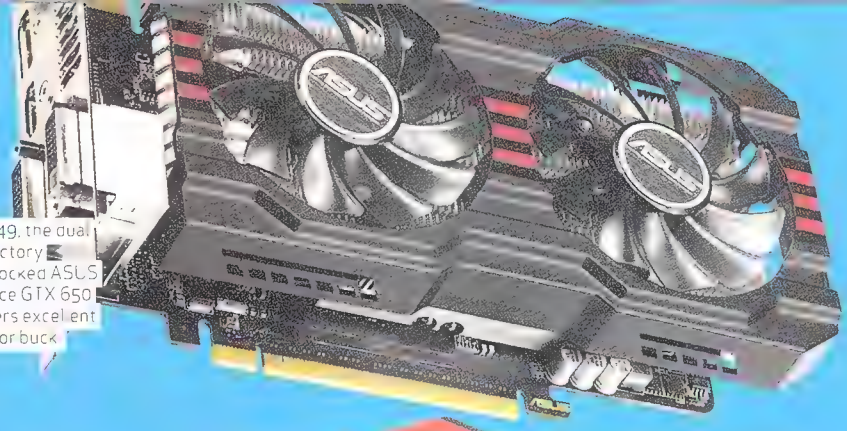
DO YOU REALLY NEED A NEW BOARD?

If you're upgrading to double-card gaming, a new board is probably unavoidable, but if all you're looking for is added features like SATA 6Gbps or USB 3.0, that doesn't always require a new motherboard. The latter two can be had easily via PCIe expansion cards. Those expansion cards were popular years ago when motherboard integration was difficult and costly, but somewhere they lost their appeal as boards lumped in everything, ready to go. Thankfully, manufacturers kept those slots because right now, you'll be glad you have them. You can still buy four-port USB 3.0 PCIe cards and dual-port SATA 6Gbps PCIe cards under $40 each from many retailers.

When it comes to sound, we would never recommend motherboard-integrated audio options. Radio-frequency interference (RFI) is impossible to completely remove from inside a PC chassis and external USB sound cards (that work fine with USB 2.0 HighSpeed ports) are far more portable from build to build. If you're looking for a solution, ASUS' Xonar U7 sits around the $100 mark. For an expansion slot sound card, ASUS' Xonar Essence STX is hard to beat under $200.

Remember: while a new board can give you new functionality, it's the toughest way to get it, and you'll only get the same level of performance with the same CPU. Let expansion cards do what they do best — add newer features for fewer dollars and in most instances, fewer headaches.

UPGRADE
best value



For $149, the dual fan, factory overclocked ASUS GeForce GTX 650 Ti offers excellent bang for buck

The MSI Radeon R9 270X costs $300, but comes with an upgraded cooler, factory overclock and *Battlefield 4* gaming bundle

$379 gets you a HIS R9 280X IceQ X Turbo GPU, with an oversize heatsink, out of the box overclocking and upgraded power regulation

PIXEL PUSHERS

Running games is hard work. Lindsay Handmer uncovers the best-value graphics card upgrades.

Whether you use it for gaming or for GPU-accelerated software, graphics card performance can make or break an older PC. Fortunately, a relatively inexpensive upgrade can often fix a graphical bottleneck and give your PC a new lease on life. As tempting as it might be to go for the fastest $800-card money can buy, an older system won't get the full benefit and, in terms of bang for buck, it's actually more efficient to buy a low- or mid-priced card. It's also critical to compare the performance on your existing card to any upgrade – there is no point buying a cheap video card to replace your older (but high-end when new) Nvidia GeForce GTX 570, for example. While AMD's new R7 and R9 cards were excellent value when they launched late last year, frustratingly, the popularity of mining cryptocoin (ie Bitcoin) has pushed up the cost of AMD's GPUs by as much as $50.

> "Despite costing less, the 650 Ti is actually a little faster in most games, making it the clear winner in the budget sector."

UNDER $150

The AMD Radeon R7 260X used to be the clear champion in this price segment, with models available under $150. But now with 260X prices creeping towards $200, Nvidia's GeForce GTX 650 Ti is making a comeback. Despite costing less, the 650 Ti is actually a little faster in most games, making it the clear winner in the budget sector. Make sure you get the Ti version – not just the vanilla 650 – as it sports extra shaders.

UNDER $300

The undisputed performance king in this $300 price bracket is the powerful AMD Radeon R9 270X. While prices have been high, they're just starting to drop, so make sure you shop around to get a good price. It's also worth noting that the 270X is a bit of a hot running card and it'll automatically throttle back its clock speeds if it gets too toasty, in turn lowering performance. If you have a tight case or a hot running PC, it could be worth paying a little extra for a model with an upgraded aftermarket cooling system.

UNDER $400

For a high-end but still affordable GPU upgrade, the Radeon R9 280X is cheaper and faster than the nearest Nvidia competitor – the GeForce GTX 770. Thanks to its popularity as a mining card, the Radeon R9 280X is a good $40 more expensive than it was late last year. Make sure you compare prices, but as a general guide, if you pay less than $400 you're on to a winner. Like its brethren, the 280X runs hot, so keep an eye out for models with upgraded cooling solutions.

BANG FOR BUCK

No matter your price point, you want to maximise your bang for buck. One of the easiest ways of doing this is to overclock your GPU – most graphics card vendors even provide software to do just that. If you're looking for a simpler solution, look for factory-overclocked cards. These can often be found for not much more than the stock cards and generally come with upgraded cooling systems, making them excellent value over stock GPUs. Also check for any gaming extras – some Radeon R9 270X cards are now shipping with *Battlefield 4*.

NEW NVIDIA CARDS ARRIVING SOON?

AMD has been dominating the lower end of the graphics card market, but Nvidia is preparing to fight back. According to leaked reports, the company is about to launch GeForce GTX 750 Ti which will offer a decent 20% performance boost over the GTX 650 Ti – and it should therefore dominate the AMD Radeon 260X.

Australian prices were still TBC at the time of print, but they should be on par with the GTX 650 Ti and will no doubt help pressure AMD to drop its own prices.

An artificially intelligent comedy from the director
of ***Funny Ha Ha*** and ***Mutual Appreciation***

COMPUTER CHESS

"...CLOSE TO PERFECT."
–Amy Taubin, *Film Comment*

a film by
ANDREW
BUJALSKI

WINNER
ALFRED P. SLOAN PRIZE
SUNDANCE
FILM FESTIVAL
2013

OFFICIAL
SELECTION
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UPGRADE
best value

Corsair's XMS3 with built-in heat spreaders handles higher-performance needs

DDR3-2666 RAM only makes sense if the rest of your system is top-drawer.

MORE HEADSPACE: ADDING PC MEMORY

How much RAM is too much and when's the best time to quit? Darren Yates explains the best-value memory upgrades.

Memory costs over the last few years have been pretty stable – and surprisingly low. Even the big-name PC brands have been able to include at least 4GB of RAM on most systems, thanks largely to a market glut and a stable DDR3 RAM platform since 2007.

But whereas the arrival of a new technology in other areas generally sees preceding tech fall in price, RAM is the reverse – the older it is, the more expensive it becomes. For example, standard-speed DDR3 sells for around $12 per GB; DDR2 is nearer to $20.

KNOWING WHEN TO QUIT

Back in the bad old days when systems arrived with 1GB of RAM or less, simply adding more of it made a difference to system performance, but that's because there just wasn't enough of the stuff to begin with.

The reality today is that, if you're using a 32-bit operating system, anything more than 4GB is a waste; due to 32-bit addressing limitations, the OS can't actually access anything beyond around 3.3GB anyway. Add more than that and you need a 64-bit OS running your system. Having more RAM allows you to open more files and apps, maintaining speed before the system has to call on the hard drive page file (an overflow for memory held on your much-slower hard drive) for help. What adding more RAM can't do, beyond a minimal level, is make your system process data faster – that's your CPU's job.

HOW MUCH IS ENOUGH?

We'll keep this simple – for standard applications such as gaming and occasional home video editing on a 64-bit Windows 7 or Windows 8 build, 8GB is more than enough. If you're a professional video or image artist and deal with large files or you're planning a RAM drive, 16GB may be worth considering; but otherwise, it's unlikely you'll see much value from the extra cash you need to spend. Adding extra RAM to older systems is even more wasteful, because they already have less processing capacity to meet today's performance requirements.

"The reality today is that, if you're using a 32-bit operating system, anything more than 4GB is a waste; due to 32-bit addressing limitations."

KEEP OR DISCARD?

The next question when upgrading memory is whether you should keep the RAM you currently have, or discard it all and start again. Obviously, if you determine you need more RAM but have no free slots, you have to begin from scratch. In this case, go for the highest-capacity stick(s) your board can handle up to that 8GB mark (check your motherboard manual or product web page on the manufacturer's web site).

If you have spare slots, check the capacity, speed and voltage of your existing RAM and aim to match at least those last two parameters with new sticks. Ideally, you'll want to match the sticks you already have exactly for brand, capacity and speed. However, you can theoretically mismatch capacity without issue, even mismatch speeds and have all RAM running at that of the slowest stick, but mismatched RAM voltages may lead to serious problems.

HOW FAST?

If you're building a system for standard applications, you don't need 'hero' RAM, the high-priced, high-clocked stuff, unless you're overclocking or gaming.

Games like *Crysis* and *Far Cry* have reportedly shown upwards of 10% frame rate gains by jumping from DDR3-1333 to DDR3-2666 RAM. But apart from the extra $100 or so cost, your motherboard has to also support running at that speed – for Intel systems, that means a Z-series motherboard at a minimum, not to mention having a decent system build to make it worth your while.

The bottom line: 8GB of heatsink-free DDR3-1600 RAM is the value sweet-spot for most systems out there.

UPGRADE
best value

NEED FOR SPEED: WHICH SSD IS BEST?

Need to light a rocket under your storage? Solid-state drives could be the answer. Darren Yates investigates the best options.

SanDisk's Extreme II, one of the fastest consumer-grade SSDs available — at a price.

Everyone's thinking SSDs at the moment. They deliver transfer speeds that can be only surpassed by RAM, but while they're great in a new system, they can present issues in older builds.

HORSES FOR COURSES

All new SSDs conform to the SATA 6Gbps (aka SATA III) data interface, but to get maximum performance, your PC's motherboard must also support SATA 6Gbps. You can plug a SATA 6Gbps SSD into a SATA 2 port and it'll work, but you'll only get SATA 2's 300Mbps max performance – that means around 300MB/s transfer speeds instead of whatever the actual drive peak is (around 450-600MB/s typical, depending on the brand and type of drive). A SATA 6Gbps PCIe expansion card can fix this for under $25, but if the rest of the system isn't up to scratch, this might be a false spend.

GARBAGE IN...

There's also a more complex issue surrounding data garbage collection, a feature called TRIM. SSDs require the operating system to regulate the collection of abandoned (used but no longer needed) storage cells, without which, your SSD will seem like a write-once drive and eventually slow down to a crawl. TRIM commands are issued by the OS for the drive to collect those abandoned cells for re-use. To enable that collection to take place, these commands have to be passed through by the motherboard chipset's SATA hardware to the SSD. That means you need to ensure your OS and hardware drivers are up to scratch.

At the OS level, Window XP and Vista don't support TRIM at all – what's more, XP and Vista need to have their defrag options manually switched off, otherwise, they'll kill an SSD through their automatic-defragging 'kindness'. If you want to use an SSD, we recommend Windows 7 at a minimum.

WEAR AND TEAR

The next issue gets us to which drive to buy. SSD cells have a limited write-cycle lifespan based on their cell architecture – single-level cells (SLCs) last around the 100,000-cycle mark, multi-level cells (MLCs) about 10,000 and triple-level cells (TLCs) somewhere near the 1,000-2,000 mark. Clearly, SLC SSDs have the longest lifespan, but they cost considerably more as a result. However, all SSD controllers are designed to spread the wear around to maximise cell life, so the more cells there are, the longer each one survives.

Concern over SSD wear in system drive use has even seen the return to popularity of RAM disks, letting you turn excess RAM in 64-bit systems into temporary RAM drives for pagefile and browser caching needs. While this does work, you need a system that's well-equipped for RAM to go to the trouble.

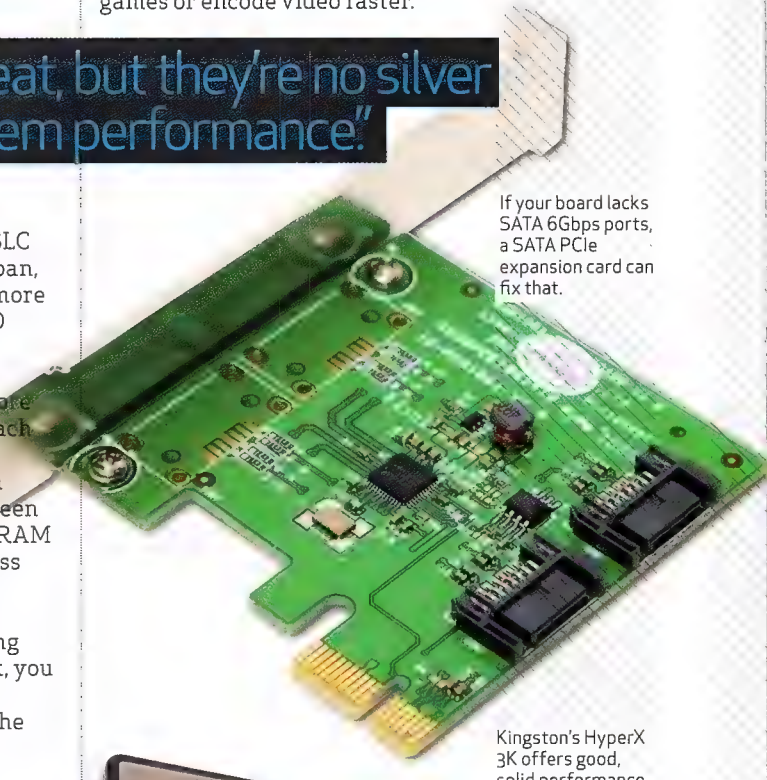
CHOOSING A DRIVE

Obviously, a big SLC SSD would go down a treat – long-life cells and lots of them. But the wear-levelling techniques can still make TLC SSDs last a number of years – it depends on how hard you thrash them. Simply, the more you use them, the quicker they wear out. Intel and Samsung drives have the best reputations for reliability. After testing, we also like Kingston's HyperX 3K drives – MLCs with 3,000 program-erase cycles and 500MB/s+ read/write speeds at about $1 per GB. SanDisk's Extreme II range is also worth noting – it's more expensive but has excellent speed.

IS IT WORTH IT?

SSDs are great, but they're no silver bullet to system performance – they speed up data transfers, not processing. If your system CPU is dragging the chain, an SSD can make it feel a bit zippier, but your PC won't play games or encode video faster.

> "SSDs are great, but they're no silver bullet to system performance."



If your board lacks SATA 6Gbps ports, a SATA PCIe expansion card can fix that.

Kingston's HyperX 3K offers good, solid performance at around $1 per GB.

UPGRADE
best value

Antec's 550-watt VP550P, a budget PSU made by Delta Electronics.

"Almost all third-party/after-market PC cases that are mid-sized or larger will have no trouble with standard ATX PSUs."

Seasonic's new 750-watt S12G is a good performance-oriented PSU choice.

MORE POWER TO YA: THE BEST-VALUE PSU UPGRADES

Upgrading the rest of your system? Don't forget about the power supply unit. Darren Yates explains why.

Out of sight, out of mind – that's about as much love as the average PSU gets from most upgraders. Yet you read stories of "I was playing this new game with my new graphics card and the computer died" and they wonder why.

PSU 101

A PSU is the bridge that links your PC components with the national supply grid in such a way as they don't all blow up. Collectively, in electrical terms those components are described as the load that the PSU has to supply power to. All PSUs have a limited capacity to supply power however, which is set by the electronics inside; the idea is that you ensure the load from your components doesn't exceed the power rating of the PSU. That way, everything stays happy. PSUs deliver various voltages (known as voltage rails) to the computer to drive different components. That includes things like 3.3V, 5V and 12V rails to the motherboard or 5/12V rails to the storage drives – but they're all monitored by the motherboard to ensure they remain within tolerance.

UPGRADE PROCESS

Most upgrades go without a hitch, but problems can occur when you start with a modest system and upgrade it significantly, particularly when it comes to gaming and CPU builds.

The two most power-hungry components in a PC are the CPU and the GPU on the graphics card – combined, they can add up to as much as 80% of the total power consumption. If you crank up the power load considerably (ie. by adding higher-performance components) but you don't also look at the PSU's ability to handle that load, you're asking for nasty surprises that go bang.

Before you purchase or install a new graphics card, check with your GPU maker's web site and look for the minimum recommended PSU wattage spec for that specific GPU – make sure your PSU matches or beats that spec and you should be right.

An AC power meter can be useful for AC-watts (VA) measurements.

PSU SIZES

Almost all third-party/after-market PC cases that are mid-sized or larger will have no trouble with standard ATX PSUs, as they're designed to bolt to standard hole fittings. But if you have a name-brand PC – from Dell, HP, Acer, Alienware and so on – you'll want to check the original PSU first, as it may not be standard, making replacement difficult. Small form-factor (SFF) PCs may require more specialised PSUs to fit, so it's important to understand the PSU and case cavity you're starting with before you charge off in search of an upgrade.

PSU RELIABILITY

We often hear the one about no-name PSUs being a time bomb for your PC – but conversely, you shouldn't kid yourself that every big-name model is perfect. Forget the name on the PSU box – find out who manufactured that model and you'll know much more about its likely reliability. For our part, we recommend PSUs made by Seasonic, whether sold under its own name or OEM'd for other brands, which includes the likes of Antec and Corsair. Another good-value manufacturer is Delta Electronics, who makes Antec's $80 550-watt VP550P – that PSU's not our pick for silent builds, but it's a good-value option for single-card mid-range (GeForce GTX 760 or equivalent) gaming and general system upgrades. Seasonic's new 750-watt S12G at around $160 is our performance pick for any new top-drawer single-GPU card or mid-range SLI/Crossfire setup – it even comes with four PCIe power connectors for the job.

Seagate's 5,900rpm Pipeline drives are similar in performance and price to WD's Caviar Green line.

GET MORE STORAGE: HARD DRIVE UPGRADES

Whatever you do, you can't do it without storage. Darren Yates digs up the best-value hard drive upgrades.

PCs generally get upgraded because they either run out of space or they slow down, which itself is often caused by running out of space. The SATA interface makes physically adding new storage relatively easy, but knowing what to add is the tricky part.

BUSTING SIZE LIMITATIONS

The biggest change effecting storage in the last few years has been the introduction of the BIOS-replacing Unified Extensible Firmware Interface (UEFI). Among other things, it heralded the arrival of the GUID Partition Table (GPT) system, which Intel had been using on Apple's Mac computers for a number of years. One of the main reasons for the change was the BIOS we'd used for 30 years had hit the wall. The BIOS' master boot record (MBR) stores drive block addresses as 32-bit numbers, leaving us a 2TB drive-capacity ceiling. The only way around it was to introduce the GPT, but that does nothing for pre-UEFI systems. You can run 2.5TB or larger drives in those older systems, provided you're not running 32-bit Windows XP, but usually not as a bootable drive.

DRIVE SPEED

The other issue to consider is drive colour – do you choose a green, red, blue or black-grade drive? This is mostly a Western Digital thing, but all major drive makers have different drive grades for various applications.

> "Mid-tier 7,200rpm drives (such as WD's Blue line) are the everyman's compromise between price, performance and reliability."

Performance-grade (7,200rpm) drives are the top-drawer for speed and reliability – though not necessarily power consumption, noise levels or price. Budget 'variable speed' or 5,900rpm drives, like Seagate's Pipeline and WD's Caviar Green drives, are typically slower and quieter, generally have the least power consumption and often give you maximum storage per dollar, making them well-suited to older systems or use as pure storage drives (for throwing your movies and music on, for example). Mid-tier 7,200rpm drives (such as WD's Blue line) are the everyman's compromise between price, performance and reliability – and they're not a bad choice, but are often limited to lower capacities.

The new UEFI BIOS system, designed to overcome the 2TB MBR drive capacity limit.

NAS-GRADE DRIVES

WD's Red drives and other brands' similar NAS-grade offerings are different – they're moderate performance (5,400-5,900rpm), high-reliability drives designed for RAID/NAS server applications. The most oft-asked question about these is, "Can I use them as stand-alone drives in a desktop?". The short answer is, "Yes, but don't".

These drives enable a feature called, among other things, TLER – Time-Limited Error Recovery. Essentially, it's a negotiated error correction system between the drive controller and the RAID controller these drives expect to see. TLER gives the drive typically seven seconds to fix small errors before timing out with an 'error' condition, allowing the RAID controller to fix it in minimal time. Without TLER, a minor sector fault could trip the RAID controller's error time limit and incorrectly deem the whole drive unserviceable, forcing you to do a full RAID array rebuild. However, without RAID Red drives are quicker to 'error out' in a desktop scene.

Green-grade drives don't use TLER, making them better-suited to desktop use (they don't give up on sector errors as easily) but they're horrible for RAID applications as they can unnecessarily trip RAID controllers into rebuild mode.

THE SWEET SPOT

For basic system upgrades, 1TB Blue grade drives are decent and good value at around $70, but WD's only come with a two-year warranty. You'll find 2TB Green drives selling for $100 – like all 2TB drives, they work in pre- and post-UEFI BIOS builds, so they're a good cross-over but they're slow, and again, only offer a two-year warranty. For serious storage, Black performance-grade drives give you speed, reliability and up to five years' guarantee – for a premium.

UPGRADE
best value

The 30-inch HP ZR30W is by no means cheap, but the 2,560 x 1,600 resolution and IPS panel do help make up for the $1,600 price tag.
For $265, the AOC e2752Vh is an excellent 27-inch LCD, with 1,920 x 1,080 resolution and a low 2ms response time.
AOC
With a 4K (3,840 x 2,160) resolution and a 31.5-inch IGZO panel, the Dell UP3214Q is one of the best-quality screens $3,500 can buy.
DELL

EYE PLEASING SCREEN UPGRADES

Nothing improves the feel of using your PC like a new monitor. Lindsay Handmer looks at the best displays, from large to small.

When you stare at a computer screen all day, one the best yet most affordable upgrades is a new monitor. Sure, it won't give you a better frame rate when gaming, but it will make your general computing experience a whole lot more enjoyable.

BUDGET OPTIONS

It's easy to buy a large 24-inch (or 23.6-inch) monitor on a sub-$200 budget. At that size and price, you can expect to get a 1,920 x 1,080 resolution, LED backlighting and 5ms or better refresh rates. Generally they feature panels based on TN (twisted-nematic) technology. TN gives the best response times, although it typically has narrow viewing angles and isn't as colour accurate as an IPS (in-plane switching) or VA (vertical alignment) counterpart. That said, for gaming, watching movies and general computer use, TN panels offer good bang for buck. These affordable monitors typically come with inbuilt speakers (though they're middling at best), HDMI and DVI inputs and have a range of preset modes for different uses. If you want a smaller monitor, don't expect them to be any cheaper.

UPSIZING TO 27-INCH

Jumping up to a larger monitor doesn't have to cost a lot – there's a lot of choice under $300. Most 27-inch models use a 1,920 x 1,080-pixel resolution, have LED backlighting and a 5ms or better refresh rate. The more affordable models feature TN panels, although starting from around $350 you can jump up to an IPS screen. These feature better colours and viewing angles, but often lower refresh rates and are arguably overkill for budget gaming. Make sure you have the desk real estate for a 27-inch monitor – they take up more room than you might expect.

MONSTER SCREENS

While the idea of a massive 30-inch LCD might sound nice, models this large are rarely affordable. Generally targeted at designers and other professionals who need high-quality, high-res screens, there are very few cheap 30-inch options available. To upgrade to this size you'll be looking closer to $1,500-$2,000 (or more). One notable exception –priced at $649 – is the 29-inch Dell UltraSharp U2913WM, although its extra wide format (at 2,560 x 1,080 pixels) makes it slightly smaller than you might expect.

If a huge screen for gaming or movie watching is your true heart's desire, it could be worth considering a TV instead; you can pick up a 1,920 x 1,080 40-inch TV for under $500. Keep in mind that you will need to sit a lot further back, otherwise things like text will look fuzzy and indistinct. For an even larger screen, a 1080p projector can throw an image over 100-inches but is still a surprisingly-affordable choice; you can find models for under $1,000.

Costing just $175, the 23.6-inch ASUS VE247H is an affordable, good-quality screen with a 1080p resolution and low 2ms response time.

WHEN QUALITY COUNTS

For image and video editing, you need excellent colour reproduction, higher resolutions and the best possible contrast levels. Many manufacturers produce high-end monitors designed to give the very best image quality possible. Expect to pay at least double for the same size. Most high-end monitors use IPS panels for more accurate colours and wider colour gamuts (more hues, effectively), although VA panels offer almost as good quality for a lower price. 27-inch or larger monitors will often feature high 2,560 x 1,440 resolutions. For even higher resolutions, some new 31.5-inch monitors offer 4K resolution – or 3,840 x 2,160 pixels. ■

disc contents

» OUR SELECTION OF EXCLUSIVE FULL-VERSION PROGRAMS

ISSUE 400 MARCH 2014

All-in-one burning solution

Back up your data, movies and music with Ashampoo Burning Studio 2014.

SPECIAL EDITION

With Ashampoo Burning Studio 2014 you are well equipped for all burning tasks, whether they involve movies, music or simply files. Create backups or data discs, rip music and create audio CDs or simply archive your movies to Blu-ray discs — the highly improved usability and sleek design make Ashampoo Burning Studio 2014 the ideal choice for all burning-related tasks.

CLEAN UP YOUR PC

Get rid of old and unnecessary data with 1-abc.net Hard Drive Washer 7.

FULL VERSION WORTH $22

Windows and nearly all other software programs installed produce temporary data. Unfortunately, if it isn't properly removed, this leftover data can clog up your system and slow your whole PC down. 1-abc.net Hard Drive Washer does what all these programs forget to do: it searches for these unnecessary files and gives you the ability to delete them.

ANALYSE YOUR SYSTEM

Monitor and maintain your storage space with Abelssoft FolderVisualizer 6.

FULL VERSION WORTH $15

Where did my drive space go? FolderVisualizer inspects your PC and storage devices and finds space-wasting files and space-intensive programs in seconds. The program shows statistics and charts about your disk drive, analysing your hard disk (including USB sticks) and giving you an exact overview of which folders and files are taking up so much of your space.

PLUS! X-MOTOR RACING PLAYABLE DEMO & WORD PROCESSING ESSENTIALS TOOLKIT

SYSTEM REQUIREMENTS

- A CD/DVD-ROM reader or burner.
- The *APC* disc is designed for use with up-to-date browsers (for example, Internet Explorer, Chrome, Firefox).
- The interface included on the *APC* disc requires a JavaScript-enabled browser.
- An internet connection may be required for online registration of software before use.
- The software packages on the *APC* disc have different system requirements. Software is included on the disc for Windows XP, Vista, 7 and 8.

BEFORE INSTALLING

- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the *APC* disc, click the 'Help' button at the top of the screen.

USING THE DISC

- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

HELP

- If you have any problems with the *APC* disc, please visit **www.apcmag.com/disc.htm**.
- *APC* provides no technical support for this disc or any software provided on it.

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50 UPGRADES

THAT WON'T BREAK THE BANK

SEE WHAT WINDOWS 7 CAN REALLY DO WHEN IT'S TREATED TO SOME ATTENTION! BEN ANDREWS REVEALS 50 OF THE BEST TWEAKS AND APPS TO UPGRADE YOUR OPERATING SYSTEM.

Windows 7 is packed with features, many of them honed over years of development, so you could be forgiven for thinking Microsoft must now have covered every base and satisfied every need.

The reality is rather different, as anyone who's had to fork out for an additional antivirus package will appreciate. People tend to forget that essential virus protection, along with programs like Word and Excel, aren't included with Windows, but are actually pricey upgrades. Don't worry though, because there are free alternatives out there that are just as good.

The trusty Internet Explorer and Windows Media Player are both great programs, but they are fending off several third-party web browsers and media players that are brimming with innovation. Likewise, Windows 7's updated Paint app may be streets ahead of previous versions, but it's still no match for a dedicated photo-editing package like Gimp.

Extra programs like these are a great way to improve Windows, but there are also plenty of improvements you can make to the core Windows tools we often take for granted. As well as sharing the best free software, we'll also show you some tricks of the trade to fine-tune the tools Windows already has. From customising Windows Update to getting the most out of Windows Media Center, there'll be something here for you.

So stop putting up with a disorderly desktop. Here's our guide to some of the best upgrades, gadgets and tweaks around to help you get the best Windows 7 experience. And most of these will work fine with Windows 8 and 8.1 too.

INTERNET & SECURITY

Tweak how you use online services.

TRY A NEW WEB BROWSER

Once upon a time, if you wanted to surf the internet, you'd ride its virtual waves using Microsoft Internet Explorer. Now in its 11th incarnation, Internet Explorer is certainly a speedy surfing companion, but rival web browsers such as Google's Chrome (**www.google.com.au/chrome**) and Mozilla's Firefox (**www.mozilla.org/firefox**) are even faster in some tests.

Google Chrome has the advantage of running each web page tab as though it's a separate program (a technique known as sandboxing), so if one tab stops responding, it won't crash all the others. Firefox comes into its own with its huge range of add-on apps, which let you customise your internet experience with gadgets galore – everything from translating web pages on the fly to blocking annoying advertisements.

ENSURE VIRUS IMMUNITY

Virus protection isn't one of Windows 7's strong points, as it doesn't come with antivirus software built in. You can fix this by downloading Microsoft Security Essentials (**windows.microsoft.com/en-au/windows/security-essentials-download**), but this optional upgrade pack is still no match for a third-party antivirus program.

You can shell out for pricey security software to give you extra peace of mind, but these days plenty of free alternatives offer great protection, features and ease of use too. Avast (**www.avast.com**) and AVG (**www.avgfree.com.au**) are both forces to be reckoned with, and receive free daily updates so your Windows PC is always equipped to take on anything the web can throw at it.

SET UP A FIREWALL

Windows comes with its own firewall to help protect you from cyber intruders. However, as with many standard Windows features, it can be improved.

ZoneAlarm Free Firewall (**www.zonealarm.com.au**) and Comodo Firewall Free (**www.comodo.com**) will both give you far more control over exactly which programs are allowed to roam free over the web, and they do a much better job of keeping virtual villains at bay, too.

Both of these firewalls are also smart enough to detect potentially suspicious programs and automatically take appropriate action, leaving you to get on with other things without worrying about net nasties. Remember to only install one firewall and one antivirus program at a time, though, otherwise they will cause no end of problems as they try to scan and block one another.

> "Plenty of free antivirus programs give great protection."

PROTECT YOUR COMPUTER FROM MALICIOUS SOFTWARE

A powerful firewall and an up-to-date antivirus package are definitely the two cornerstones of a well-protected PC, but installing Malwarebytes (available free from **www.malwarebytes.org**) will make extra sure no other malicious software can infiltrate your computer. Once it's installed, select the 'Perform quick scan' option. Click the Scan button, then just sit back while the program hunts out any suspicious software. When it's finished, right-click the results pane and click 'Check all items'. This selects every discovered threat in one fell swoop, but it'd be wise to have a quick glance at the findings and un-tick any files that may have been wrongly flagged as dangerous before removing them.

GIVE YOUR IMPORTANT FILES AN EXTRA LAYER OF SECURITY

What if your laptop and the personal documents it contains were to fall prey to a light-fingered lout? A Windows password may give some intruders the slip, but it's easily foiled.

Microsoft's answer is BitLocker – a brilliant tool that encrypts all the data on your hard drive. Unfortunately it's only included with the most expensive Ultimate and Enterprise versions of Windows 7, but there is an alternative. TrueCrypt is a free app that will protect internal or external hard disks, and even USB flash drives. It's not the easiest software to use though, so take some time to read through the detailed guide here: **tinyurl.com/pc9f4vc**.

SAVE TIME AND EFFORT BY INSTALLING SPECIALIST EMAIL SOFTWARE

Are you still logging on to a web-based email inbox every day to read your messages? Installing an email client (a program that downloads and manages your email) can not only speed up your communication, but will give you plenty of other time-saving features too.

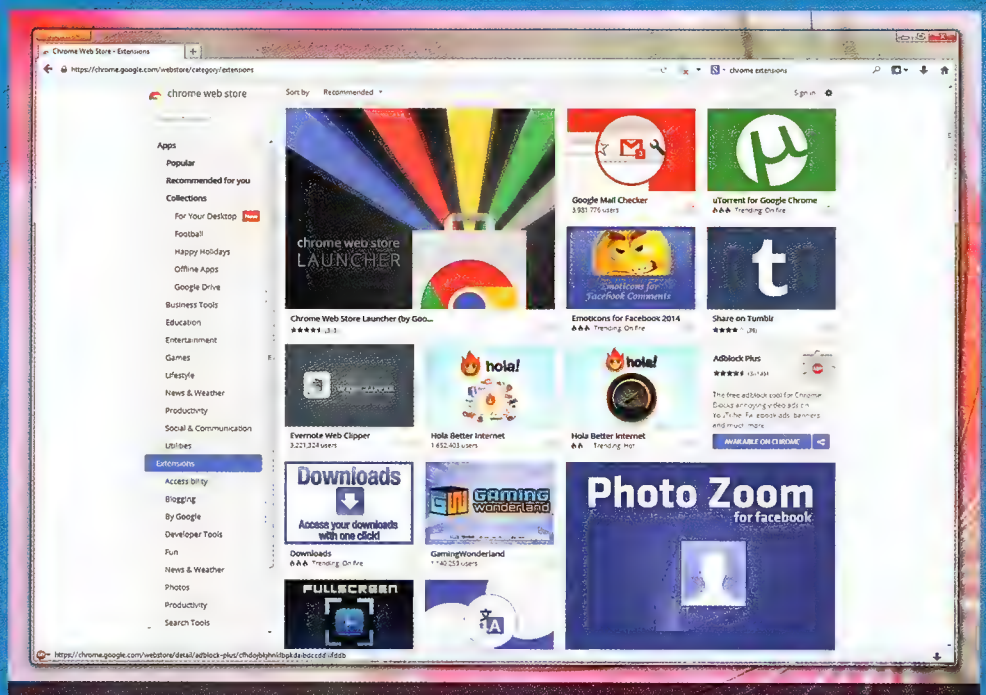
Windows Live Mail, which is incorporated into Microsoft's Windows Essentials download pack (**windows.microsoft.com/en-au/windows-live/essentials**), is the obvious place to start. It'll let you download email from Microsoft, Gmail and Yahoo accounts (along with many others), and comes with plenty of useful features such as a calendar and support for RSS feeds.

Alternatively, there's always Mozilla's Thunderbird (**www.mozilla.org/en-GB/thunderbird**). It's similar to Windows Live Mail, but can tap into Mozilla's extensive range of customisation add-ons too.

TAKE REMOTE CONTROL OF YOUR COMPUTER, WHEREVER YOU ARE

Picture the scene: you're away from your computer but really need a particular saved file or email. Wouldn't it be great if you could access your PC remotely from anywhere with an internet connection?

That's exactly what LogMeIn Free (**www.logmein.com**) can do, letting you browse your computer from another Windows PC, Mac or mobile device. You don't even need to leave your PC powered up all day either, as most can be woken remotely from sleep mode. With a fast internet connection, this nifty app will



Browser extensions

The internet is a wonderful place, and thanks to the popularity of customisable web browsers such as Chrome and Firefox, you can make your surfing experience even more enjoyable. Tweaking the look of your browser is nice, but it's the plethora of small enhancement apps called extensions that are most impressive. Whether you want to block annoying webpage adverts, download YouTube videos with a single mouse click or increase your browsing security, there'll be an extension for the job. Visit **addons.mozilla.org** to customise Firefox, or **chrome.google.com/webstore** for Chrome extensions.

have you zipping around your files as if you were at your desk.

SHARE FILES WITH FRIENDS QUICKLY AND EASILY

What do you do if you want to send a big batch of holiday photos – or even a video – to a friend? Free image sharing web sites often impose strict upload restrictions, and most videos will be too large to send via email.

Uploading to the cloud is the answer. In this sense, the 'cloud' is basically a term that refers to internet-based storage, and Dropbox (**www.dropbox.com**) is one of the most convenient providers. You get 2GB of free storage space, which is enough for sharing a few videos, or a few hundred full-resolution photos. Simply visit **www.dropbox.com**, to create an account.

MAKE FREE PHONE CALLS WITH YOUR PC, SKYPE AND A MICROPHONE

You've probably heard of Skype (**www.skype.com**), but in case you haven't, it's an excellent free app that lets you chat with other Skype users for free via your internet connection, saving you money on your phone bill.

Skype is now owned by Microsoft, but it's not included with Windows 7, so you'll need to download it from **www.skype.com**. Then it's just a matter of setting up a Skype account so you can connect to friends and family who use Skype too. You will of course need a PC microphone to be heard, plus an optional webcam if you'd like to be seen as well as heard.

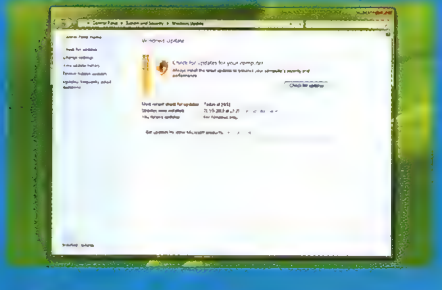
BACK UP YOUR FILES, PROGRAMS AND WINDOWS

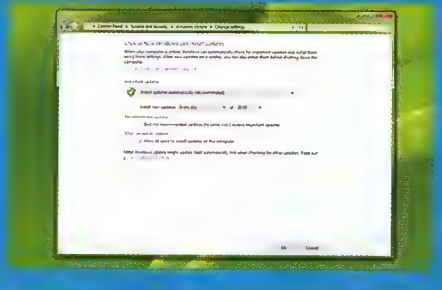
Backing up your files is the best way to protect them from viruses, as well as hard drive failure. Windows 7 includes a useful feature called 'Windows Easy Transfer' that'll create file backups, but its focus is more on shifting content from an old to a new computer.

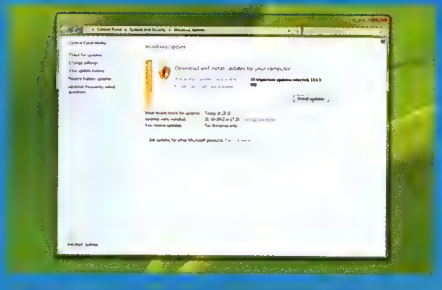
A better bet is DriveImage XML (**www.runtime.org/driveimage-xml.htm**). It's very easy to use and has the power to transfer an exact copy of all your hard drive's contents onto an external hard drive, enabling you to restore not only your files, but also Windows and programs, should the worst happen.

Configure Windows Update

Keep your machine up to date.







1 IS IT ENABLED?
To improve Windows' security, it makes sense to start by checking Windows Update is enabled. This ensures you're using the latest, most secure version of Internet Explorer, and patches any security holes identified in Windows itself.

2 AUTOMATIC OPTIONS
Click 'Start > Control Panel > System and Security > Windows Update', then select the 'Change settings' link in the left-hand pane. Here you can choose how you'd like to receive updates, and set a convenient time to install them.

3 TAKE MANUAL CONTROL
If you'd rather install updates manually, go back to the previous screen and hit the 'Check for updates' button. You can then either click the 'Install updates' button, or review exactly what's on offer by selecting either of the adjacent links.

ENTERTAINMENT & MEDIA

Organise your home time fun time.

CONSIDER YOUR CODECS

Ever found that Windows throws a wobbly when asked to play a DVD or downloaded video? Chances are Windows Media Player isn't to blame – the issue is more likely missing codecs. These clever little files tell Windows how to decode the compression methods used to reduce the size of video files.

Thankfully, Windows 7 can be upgraded with a huge range of codecs that will ensure slick playback of even the most modern or obscure video file formats. Just download and install the Combined Community Codec Pack from **www.cccp-project.net**.

WINDOWS MEDIA PLAYER ALTERNATIVES

Once you've installed copious codecs, you'd think Windows Media Player would be up for anything, but even with these upgrades, it's still not immune to issues. Supplementing it with other video players such as Media Player Classic (**www.mpc-hc.org**) or VLC (**www.videolan.org/vlc**) is a wise move.

Both players will handle pretty much any video file format, but it's their extra features that really give them the edge over Windows Media Player.

Extensive subtitle, video aspect ratio and frame rate options are all useful tools, as is VLC's ability to alter audio synchronisation so you don't have to put up with inaccurate lip-syncing.

GROW YOUR THUMBNAILS

Now you can play pretty much any video file, but you might find that Windows Explorer runs into problems when you're browsing through your video collection. It will only generate previews for certain file types, and will turn its virtual nose up at more recent video file formats, such as the newer MKV standard.

You can broaden Windows 7's thumbnail-generating horizons using Icaros (**www.videohelp.com/tools/Icaros**). Simply install the software, open it and select the video formats that you'd like to generate thumbnails. Once that's done, click the large 'Activate Icaros' button and hey presto, extra video thumbnails in Windows Explorer!

EDIT YOUR PHOTOS FOR FREE

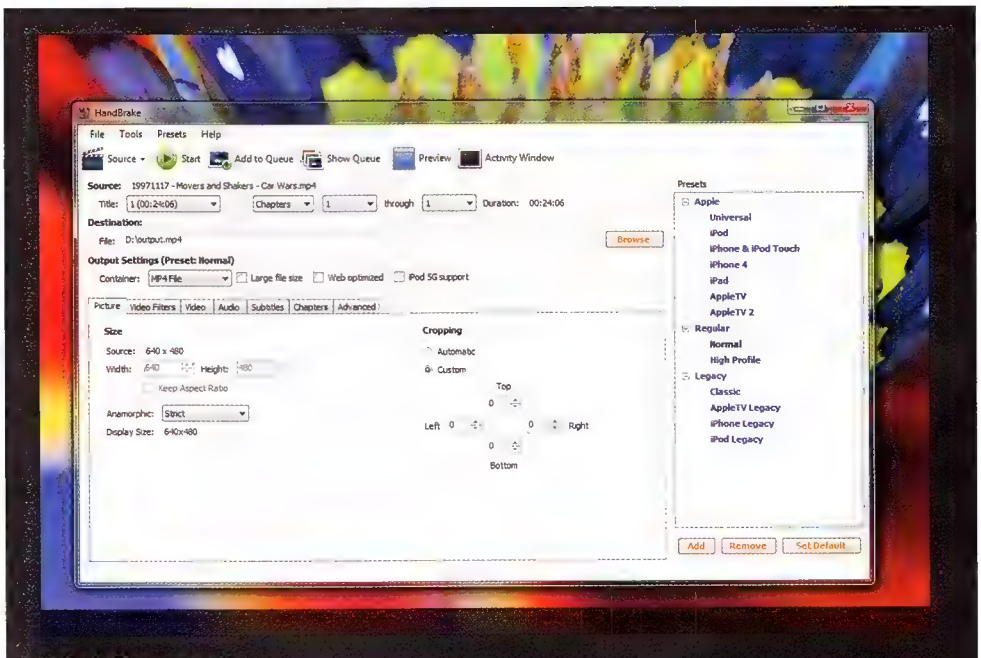
One area where mobile devices such as smartphones and tablets seem to have put the good old PC in the shade is the availability of free and user-friendly photo editing apps. All Windows 7 can offer is its Paint app, but despite improvements over previous versions, it's not exactly what you'd call impressive.

All is not lost though, because free photo-editor Gimp (**www.gimp.org/downloads**) has the power to crop or resize an image for emailing, boost colour saturation, or brighten up murky shadows. There are plenty more features to help you turn a mediocre snapshot into a photographic masterpiece, and it won't cost you a cent.

VIEW PHOTOS IN STYLE

It's easy to take Windows Explorer for granted. After all, they're the actual windows we use to browse our files and folders. Trouble is, even with customisable thumbnail sizes, it's not really the best way to view things like photographs.

Google's Picasa (**http://picasa.google.com.au**) is much more impressive. Its file browser makes it far easier to customise your viewing preferences and organise photos and videos, and there's seamless integration with some very nifty photo editing tools. Picasa also includes a dedicated photo viewer, which offers a noticeable improvement in speed and usability compared with the version in Windows.



Mobile media

Smartphones and tablets make it easy to watch videos on the go, but many devices will only play a handful of the dozens of video formats out there. Fortunately HandBrake (**handbrake.fr**) will re-encode most types of video file into a mobile-friendly format, though slower computers could need an hour or two to process a feature film.

If you're planning to watch videos on the move, you should choose the MP4 video format to ensure compatibility with Apple and Android hardware. While you're at it, you might also want to shrink the video frame size of HD footage so it takes up less storage space on your device.

TAKE SCREENSHOTS EASILY

Sometimes you see something on your PC that you just have to capture and share, but the conventional Windows way of taking a screenshot is a bit of a faff – press 'Print screen', then paste the resulting grab into an image-editing program.

SpeedCap, which you can download free from **http://cnet.co/1acbK1X**, is a much better alternative. Simply double-click the downloaded file, then click and drag a box around the area of the screen you'd like to capture. Just like magic, a duplicate image pops up in your web browser. Right-click on it and select 'Save picture as', or go to Facebook or Twitter and hit Ctrl-V to paste your new screenshot's web link straight into a status update.

ADD A WINDOWS 8-STYLE APP STORE TO WINDOWS 7

One of Windows 8's better features is its integrated app store, which puts thousands of apps in one easily accessible place so you don't have to trawl the net to find suitable software for your PC.

You can install an app store for Windows 7 too, courtesy of AllMyApps (**www.allmyapps.com**). This free, one-stop software shop groups apps into categories like imaging, security and office, or search directly if you want something specific.

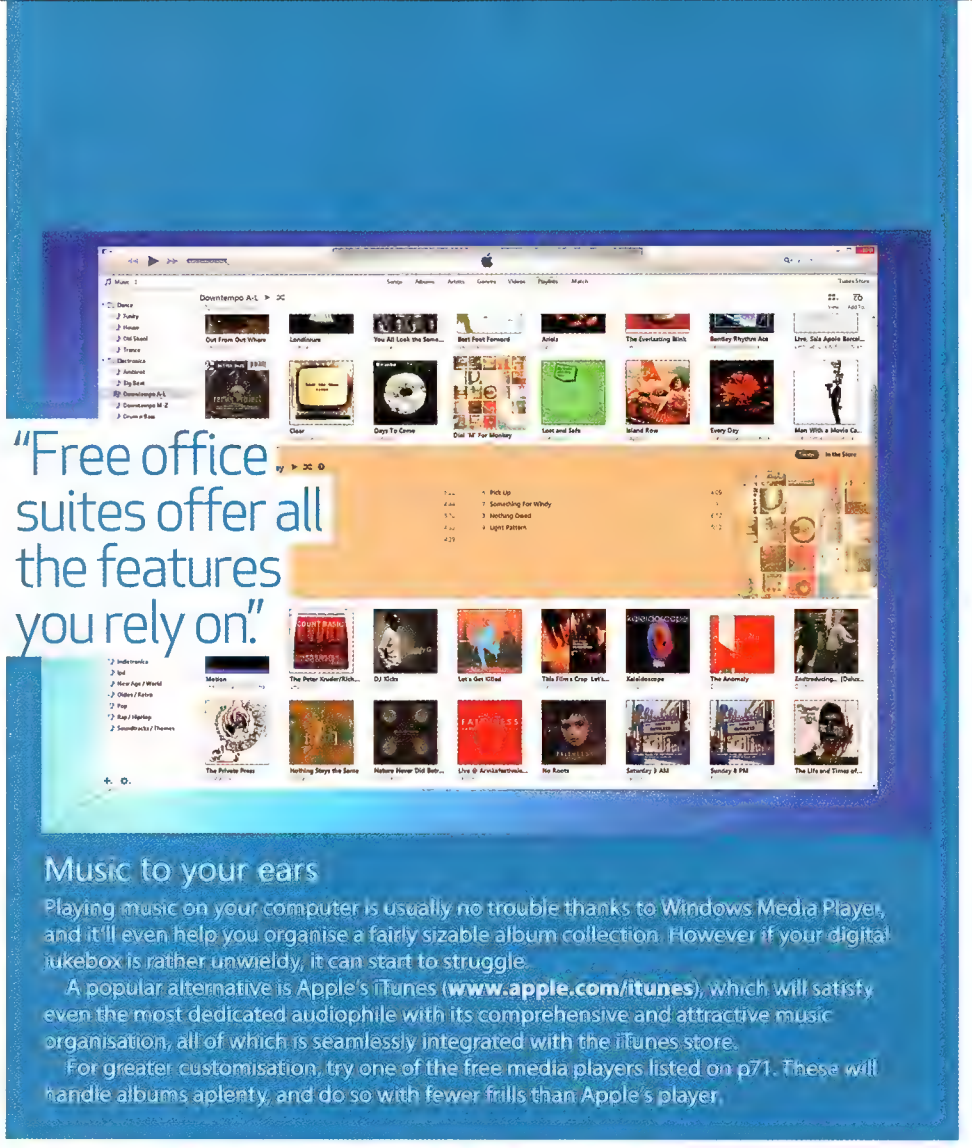
Updating existing apps is also a doddle, and you'll find plenty of information and reviews to ensure you don't end up downloading any dud programs.

GET PRODUCTIVE WITH IMPROVED OFFICE APPS

OK, office software isn't everyone's idea of entertainment, but getting a free alternative to Microsoft's Office package should put a smile on your face. Windows 7 only comes with the WordPad app as standard, which isn't much good if you're used to more comprehensive word processing software.

Thankfully, there are free office suites that offer all the features you've come to rely on. LibreOffice (**www.libreoffice.org**) includes Writer, Calc and Impress, which are dead ringers for Microsoft's Word, Excel and PowerPoint.

If you'd rather embrace the age of cloud computing, then Google Docs (**docs.google.com**) is an online office suite accessible from any internet-connected computer and comes with up to 15GB of web-based storage.



Music to your ears

Playing music on your computer is usually no trouble thanks to Windows Media Player, and it'll even help you organise a fairly sizable album collection. However if your digital jukebox is rather unwieldy, it can start to struggle.

A popular alternative is Apple's iTunes (**www.apple.com/itunes**), which will satisfy even the most dedicated audiophile with its comprehensive and attractive music organisation, all of which is seamlessly integrated with the iTunes store.

For greater customisation, try one of the free media players listed on p71. These will handle albums aplenty, and do so with fewer frills than Apple's player.

DISC-O INFERNO

Writable CDs and DVDs just can't match the convenience of a USB flash drive when it comes to carrying your files, but there are times when you may want to burn something like an audio CD, or even a replacement Windows 7 installation DVD. However Windows' own disc burning tools are rudimentary at best.

Next time you need to make a disc, give ImgBurn a go (**www.imgburn.com**). It's a free, uncluttered tool that makes light work of burning all kinds of disc content. Check out the ImgBurn forums for detailed guides explaining how to get the best out of it.

WATCH YOUR FAVOURITE PROGRAMMES ON YOUR PC WITH MEDIA CENTER

Windows Media Center is an often-overlooked feature incorporated into Windows 7 Home Premium and above. Its main goal is to make it easier to listen to music, or view photos and videos from the comfort of your living room. That's not all it can do, though – you can also use it to watch television on your computer. There is a slight caveat, though, because you'll need to add a TV tuner to your PC. Prices range from $50-$100, with some of the more convenient devices resembling a USB memory stick. Shop around and you'll find models that come with a remote control.

ZIP IT

When you're downloading files from the internet, sooner or later you'll come across a compressed file archive, commonly known as a ZIP file. However, there are many ways of compressing files together and compressing them for internet transfer, and not all forms can be extracted by Windows alone.

You'll need to upgrade to something smarter, like 7-Zip (**www.7-zip.org**). This will extract files contained not just in ZIP archives, but also the popular RAR format, plus many other compression formats. 7-Zip will also allow you to zip up your own files, with the output archive often being compressed into a smaller space than Windows could manage.

PERFORMANCE

Make sure your machine is working as hard as it could be.

MAKE SURE YOU HAVE THE LATEST HARDWARE DRIVERS

Drivers are pieces of software that tell Windows how to communicate with each item of hardware in your computer, but Windows Update doesn't always give you the latest driver versions, so sometimes you need to do it yourself.

Upgrading the drivers for your graphics card tends to provide the most noticeable improvement in performance, potentially giving you smoother HD video playback and a better gaming experience. It's easy to make sure you have the latest version – all of the big three graphics hardware manufacturers have automatic driver detection tools to help you upgrade to the most up-to-date drivers for your PC. Visit **support.amd.com**, **www.geforce.com/drivers** or **downloadcenter.intel.com**, depending on what you own.

FREE UP SPACE AND RESOURCES BY REMOVING BLOATWARE

Removing unnecessary software (also known as 'bloatware' because of the effect it has on your computer) is a great way to free up precious power reserves for an instant performance boost. The Programs and Features control panel is the usual port of call for uninstalling programs, but it sometimes leaves a few files behind. Not to worry, though, because Revo Uninstaller Free (**www.revouninstaller.com**) is a very useful app that removes traces of software that Windows misses.

When you're looking for programs to uninstall, unused web browser toolbars, expired antivirus trials and other freebie apps that came pre-installed on your computer should all be at the top of your list. Don't worry if you mistakenly uninstall something useful though, because Revo automatically creates a System Restore point when it removes an app so you can undo any mistakes.

UNLEASH READYBOOST TO GIVE YOUR PC MORE VIRTUAL RAM

This Windows performance upgrade does require some additional hardware, but don't worry, because it's something you probably have lying around the house already: a simple USB flash drive.

> "Plenty of free antivirus programs give great protection."

The ReadyBoost feature stores frequently-used files on the USB flash drive rather than your PC's hard drive, helping to speed up loading times. Not just any old flash drive will do, though – you'll need a fairly nippy one with a capacity of at least 256MB for ReadyBoost to work. To see if you've already got something suitably quick, make sure the drive is blank, then click 'Start > Computer' and right-click on the drive's icon. Select Properties, followed by the ReadyBoost tab.

UPGRADE TO A BETTER DEFRAGMENTER TO TIDY YOUR HARD DRIVE

You've probably gathered by now that a tidy PC is a faster PC, so it makes sense to not only delete unnecessary apps and files, but also organise the ones that you do want. Windows tends to scatter the data that makes up your files and folders all over your hard drive. The process of defragmentation reorganises this mess so your computer can find what it needs more quickly.

Although Windows 7 does include a defragmentation tool, it's slow and uninformative. Defraggler (**www.piriform.com/defraggler**) gives you more control, and doesn't hang around either.

TWEAK THE REGISTRY FOR FASTER TASKBAR PREVIEWS

Let's reduce the delay between you hovering over a taskbar icon and a preview window appearing.

Click Start, type `regedit` in the search box and press Enter. Using the folder menu pane on the left, double click 'HKEY_CURRENT_USER', then select 'Control Panel' and click Mouse. Now find 'MouseHoverTime' in the list displayed in the right-hand pane and double click it to reveal a new window. The number 400 in the 'Value data' box defines the delay until a preview window pops up, so decreasing this to 100 will speed things up nicely. Click OK, then restart your computer and things should be much snappier.

PARTITION YOUR HARD DRIVE TO SPEED UP LOADING TIMES

Creating a hard drive partition superficially splits it to form two virtual drives. Now you can separate your personal data from Windows and program files to speed up loading times.

While Windows 7 is capable of constructing a partition, upgrading to a free app like MiniTool's Partition Wizard (**www.partitionwizard.com**) will make the job easier and give you more options to play with. Just be sure to back up any important files before you start the partitioning process, as messing with the layout of your hard drive does carry a small risk of potential data loss.

DOWNLOAD THE ALL-IN-ONE WINDOWS REPAIR GADGET

Windows 7 makes it easier than ever before to restore or repair your operating system when something goes wrong, but there's still some room for improvement. Download Windows Repair from **www.tweaking.com**. After you've installed the software, a step-by-step tabbed interface guides you through possible fixes. Be sure to visit step four to create a System Restore point and Registry backup before proceeding to the 'Start Repairs' tab.

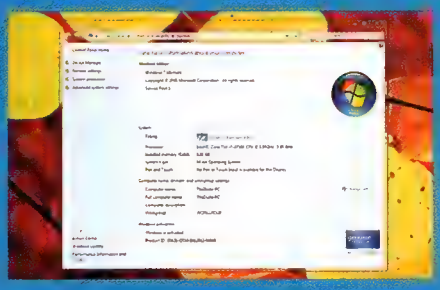
The next thing you'll see is a list of techy-sounding repair options, but clicking on a title reveals helpful tips for using it. Select only the options relevant to your PC problem, then hit Start to set the wheels in motion.

BEAT THE HEAT BY KEEPING FANS AND VENTS CLEAR

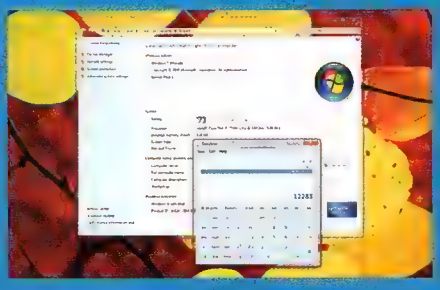
You can upgrade Windows and your other software as much as you like, but it's important to also give your computer's hardware some love and attention from time to time. You don't necessarily need to throw money

Increase your virtual memory

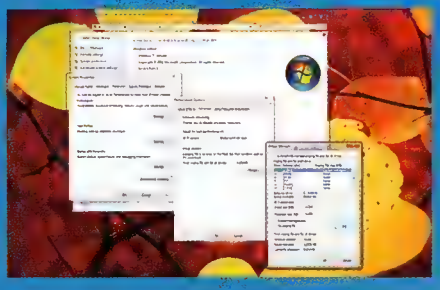
Give yourself more space to work with.



1 RAM ON YOUR HARD DRIVE?
When your computer runs out of memory (RAM), it borrows a portion of your hard drive to use as virtual memory. To improve performance by allocating more virtual memory, click Start, right-click Computer and select Properties.



2 DO YOUR SUMS
See the amount of 'Installed memory (RAM)' you have listed here? Multiply this figure by 1,024 and then multiply the new number by 1.5. Make a note of the answer, then click 'Advanced system settings' link on the left.



3 COMPLETE THE CHANGE
On the Advanced tab, click the uppermost Settings button, then the 'Advanced > Change'. Uncheck the top tickbox, choose the 'Custom size' option and enter your previously noted number in both boxes. Click Set, then OK to finish.

at it in the form of costly component upgrades though – all you really need is some common sense, and maybe a vacuum cleaner.

Excessive heat can slow a computer down and even damage its sensitive components, so try not to run your laptop nestled in a cushion or duvet where its air intake vents will be blocked. Likewise, it doesn't take long for the fans in a desktop PC to become clogged with dust, so it's worth vacuuming the dirt from its vents from time to time.

DOWNGRADE APPEARANCE TO UPGRADE PERFORMANCE

On the following pages you'll discover some clever way you can make Windows 7 look more beautiful. That's all well and good, but older computers won't thank you for slowing them down with additional visual frills. In fact, if your PC is getting on in years, you're better off losing a little style to gain some speed. Click Start, type `windows performance` and press Enter. Selecting the 'Adjust for best performance' option will disable all visual effects to give you the biggest performance boost. Click Apply. If you come across something that looks a little too crude for you, like jagged font edges, you can always return to this menu and readjust the offending option.

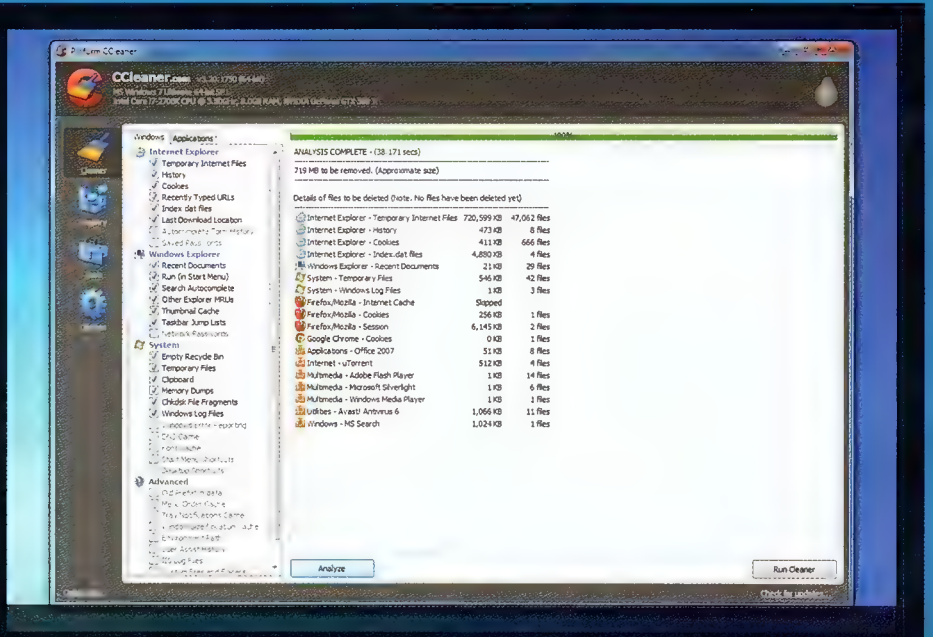
WANT YOUR PC TO PERFORM EVEN BETTER THAN NEW?

Disabling speed-sapping features will help unleash a sluggish PC, but it may also be possible to give your computer processor a new lease of life using an advanced tuning process that goes by the name of overclocking.

This can be achieved via free desktop software or through the PC's BIOS, but it's not for the faint hearted and is unlikely to work with laptops.

After the wrong setting or try boosting things too far and your PC could crash or overheat, and don't expect a warranty to pick up the pieces.

Research is essential for successful overclocking and to avoid damaging your PC, so for more information check out our sister web site, **www.techradar.com**



CCleaner

Windows 7's handy built-in Disk Cleanup tool will remove some unnecessary computer clutter, but for a more thorough spring clean to extract even more performance, try upgrading to CCleaner (www.piriform.com/ccleaner).

This free program not only eradicates superfluous, power-hogging Windows files; it'll also tidy up redundant leftovers from any web browser software, Microsoft Office apps and your antivirus package.

You can choose exactly which types of file you'd like to keep and which ones to sweep, so it's easy to clear your web browser's store of temporary files while retaining any saved web site passwords.

CUSTOMISATION

Make your system work the way you want it to.

CALIBRATE YOUR MONITOR FOR BETTER COLOUR REPRODUCTION

Calibrating your monitor means adjusting its colour output so it's as accurate as possible. You can splash out big bucks on a special device to do the job, but Windows 7 includes its own calibration tool. It's well hidden, though. To find it, type `calibrate` into the Start Menu search box. You'll be met with various simple steps to help you adjust your monitor's brightness and contrast, plus the all-important colour balance.

Don't expect dazzling image quality improvements, but if you're a keen photographer and want to view your snaps at their best, calibration is essential.

GIVE THE TASKBAR A NEW HOME

We're all familiar with the trusty Windows Taskbar down at the bottom of the screen, but did you know it can also be positioned at the top or on either side of your desktop? Simply drag and drop it to your location of choice. If that doesn't work, right-click on a blank area of the Taskbar and make sure the 'Lock the Taskbar' menu option is un-ticked.

Selecting the Properties option on this menu reveals extra Taskbar customisation possibilities, including the 'Taskbar buttons' drop-down menu which lets you revert to traditional buttons which display labels as well as icons.

GET THE WINDOWS 8 LOOK IN WINDOWS 7

Fancy the crisp new Windows 8 Start screen without the hassle or expense of a complete Windows upgrade? That's no problem – WinMetro (available free from **www.iobit.com/iobit-winmetro.php**) can transform your Windows 7 Start Menu in just a few clicks.

Add News, Weather, Finance and Photos apps, which display live updates straight to your Start screen, or choose from a selection of convenient search and social media web links. The only thing missing is Windows 8's dedicated app store, but that's easily fixed using All My Apps. Reverting back to the standard Windows 7 look is easy too, so there's no harm in giving this upgrade a try.

DISCOVER ANIMATED WALLPAPERS WITH DREAMSCENES

Desktop wallpapers are so last millennium. Isn't it time we had video backgrounds instead? It's actually a trick that was included in Windows Vista, and though Windows 7 discontinued the feature, it can be reactivated.

First, visit **tinyurl.com/9ogctnw** and download the DreamScene Activator. Once you've installed the program, open it and click the big Off slider, wait a moment until On is displayed, then restart your computer. Only WMV and MPG video formats will work, so if you're short of suitable content, head over to **www.dreamscene.org** for some cool animated backgrounds. Once you've downloaded your video of choice, right-click the file and select 'Set as Desktop Background'.

FASTER FILING

Ah, filing. It's a chore in the real world, and not much fun in Windows either. At least MyFolders (**www.coretechnologies.com/products/MyFolders**) can simplify the process for you.

Install the app, then right-click on a file you'd like to organise and find the menu entry entitled 'MyFolders'. Click it to reveal 'Copy to' and 'Move to' options,

Make over your desktop

Right-click the desktop and select Gadgets to see some handy tools, such as a calendar, news and weather feeds. It's a nice touch, but for more choice, Rainmeter (**www.rainmeter.net**) lets you choose from many more, as well as integrated app shortcuts. Everything is customisable, but it won't alter any crucial Windows files. If you want to get stuck in, click 'Rainmeter 101' at the end of the installation process for more information.

whereupon you can specify the folder you'd like to shift the file into. It's also a good idea to accept MyFolders suggestion to add this folder of choice to its favourites list, making it even easier to move files to this location.

DITCH THE START MENU

The Start menu is one of the most loved Windows features, yet searching its list of installed software to find a particular program is hardly enticing.

A quicker way to track down files and programs would be nice, and that's the beauty of Launchy (**www.launchy.net**). Once it's installed, hit Alt-Space to reveal its simple search box. Start typing the file name or program you're after and it immediately starts to list possible matches. Hit Enter to open the first item on the list, or click a different result of your choice.

COPY FILES FASTER

Simply copying and pasting files in Windows isn't something you'd imagine could be upgraded, but Supercopier does exactly that. Download and install it from **ultracopier.first-world.info/supercopier.html** and it'll automatically replace Windows 7's normal copy status window with its own.

Why use Supercopier? Well, it'll copy data faster than Windows does itself, plus it lets you pause and resume the process whenever you want. You can also cap the transfer speed to avoid your hard drive becoming unresponsive during prolonged copying, and if you start to copy a large batch of files but want to get your hands on some of them more quickly, they can be prioritised.

BYPASS DRIVER RESTRICTIONS

If you have a 64-bit version of Windows 7, you can only install hardware drivers that have been signed off by Microsoft. That's great for quality control, but if you're stuck with an uncommon or old component, chances are you may have no choice but to install an 'unsigned' driver.

Fortunately there's a way to fix this. Download and install ReadyDriver Plus from **www.citadelindustries.net/rdp.php**. This will automatically load prior to Windows and stop it disabling any drivers that aren't on its preferred list. Make sure you've installed it before installing an unsigned driver, and don't be tempted to alter any of its setup options unless you really need to.

Put up fences

Just as your real-life desk can easily descend into chaos, so too can the Windows 7 desktop. We fill it with program shortcuts and downloaded files, but Windows doesn't offer much in the way of desktop organisation.

That's where Fences (**www.stardock.com**, US$9.99) comes in. Click and drag to create a box (a 'fence') anywhere on the desktop, then move folders and shortcuts into it. You can create as many fences as you like, customise their size, background transparency and more.

ONE MONITOR, MULTIPLE DESKTOPS

Even with a well-organised desktop, you could still be struggling for space. If only there could be more than one desktop! Dexpot (**www.dexpot.de**) turns such a dream into reality by creating up to 20 virtual desktops. Apart from customising each one with a dedicated wallpaper and the icons of your choice, you can also set certain programs to open in a particular desktop. It almost gives the illusion of multiple computers hooked up to the same monitor, and is great for separating work and play.

> "Isn't it time we had video backgrounds?"

ULTIMATE WINDOWS TWEAKER

What if you're not a fan of those mini preview thumbnails that appear whenever you hover over a taskbar icon, or you'd like more control over how Internet Explorer uses tabs?

Easy, just search Google for Ultimate Windows Tweaker. Download the program and you'll be able to install and tweak settings like these and many more using one simple program. Many of these settings can of course be altered using the standard Windows Control Panel, but finding the right section can often be frustratingly slow. Although most tweaks can be easily disabled, you'd be wise to steer clear of altering anything you're not familiar with.

BRUSH UP ON THE BASICS

It's often easy to overlook some of Windows 7's own customisation features. One of the most useful is Snap. Drag a window to the left or right of your monitor and it'll automatically expand to fill half the screen. Alternatively drag it to the top to fully maximise the window.

On the other hand, if you're swamped with open windows, give the one you'd like to focus on a quick shake by clicking and holding on to its uppermost title bar, and watch as the other windows minimise. Another shake restores them to where they were before. ■

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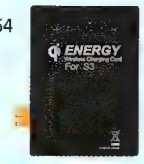

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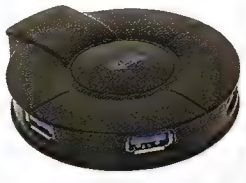

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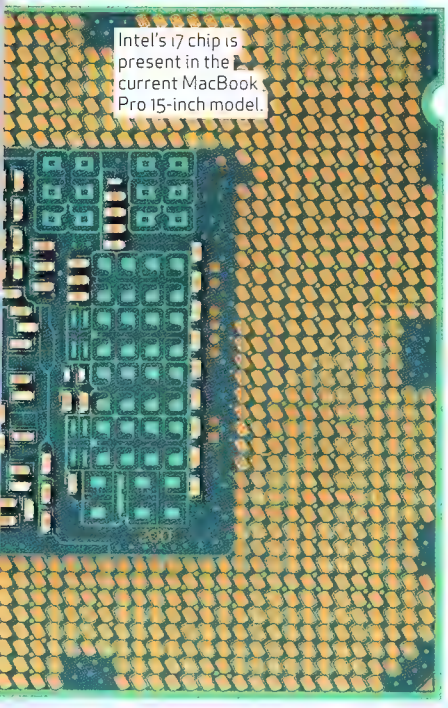
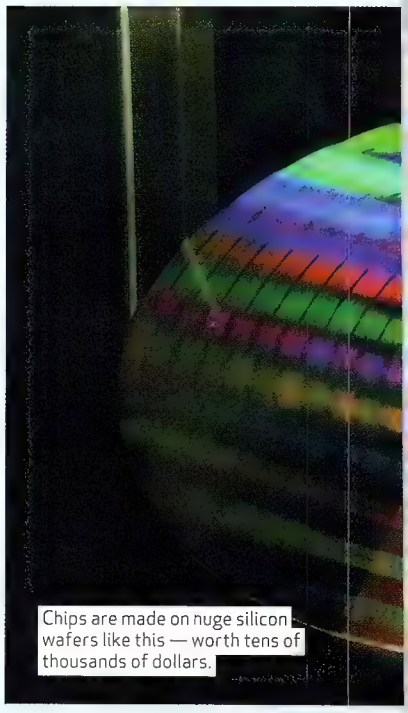

Intel's i7 chip is present in the current MacBook Pro 15-inch model.


Chips are made on huge silicon wafers like this — worth tens of thousands of dollars.

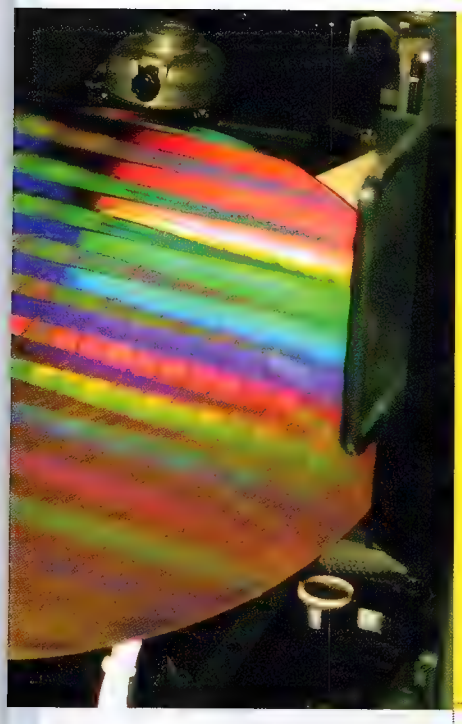
WILL THE NEXT MAC RUN ON AN APPLE A7 CHIP?

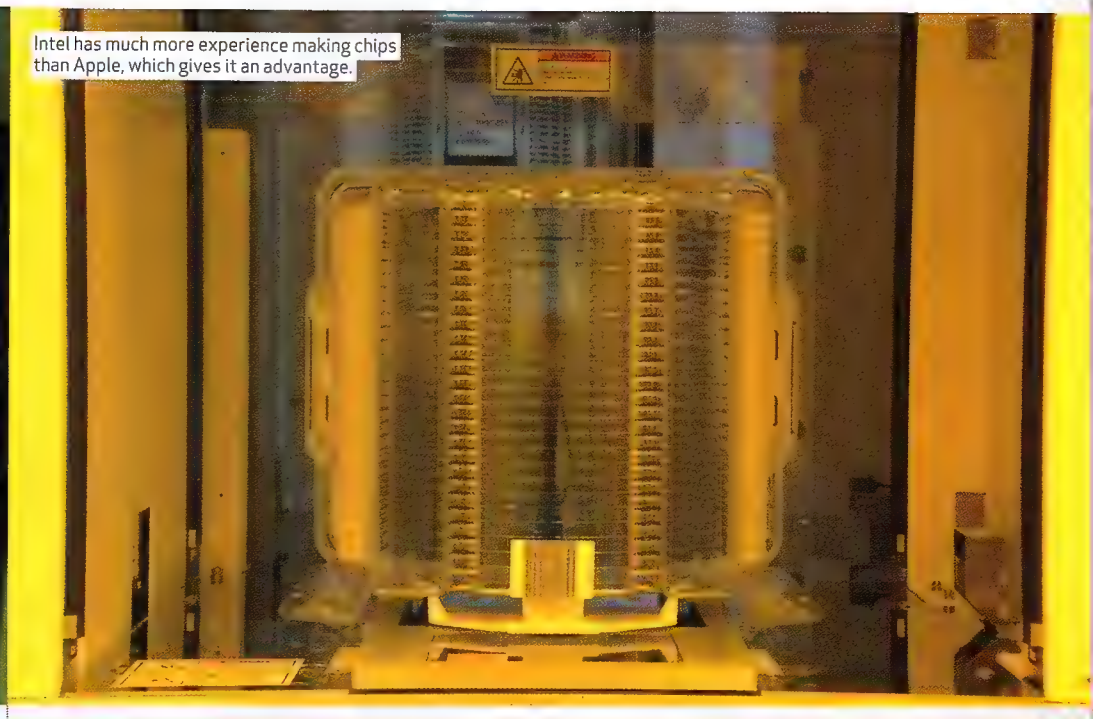
Could Apple's iPhone and iPad chips really replace Intel? looks at what it would take to get there.

The short answer? No, there will not be a Mac that runs on the A7. It just doesn't have the performance. But an A9 or A10? That's less clear. Rumours that Apple is looking to replace Intel's processors in its Mac range have circulated ever since the company first revealed that it was making its own chips for the iPhone and iPad. Apple's success has been built on integration and the idea of controlling everything from the development of the hardware to the optimization of the software to make it the best possible experience. Macs, however, use a lot of third-party hardware in their construction, with Intel's chips being one of the most prominent. This partnership has offered great advantages, with Intel's and Apple's priority largely in alignment at the moment: power management. Apple's best-selling Macs are its laptops, and with Intel having previously focused on computing power over energy usage, it's now putting its considerable effort into making its mobile chips as electrically frugal as possible – a process that has resulted in the excellent battery life on the latest MacBook Airs. Yet Intel is still miles behind the technology that underlies Apple's A-series chips.

The architecture of Apple's chips has two advantages when it comes to power use: it uses a different way of processing information that's more efficient, and the chips are less complex in design. The flipside of being simpler, though, is that they're less powerful – the dual-core A7 in the iPhone 5s appears to be slightly more than a third as powerful as the Intel Core i5-4250U processor in the latest MacBook Air. Both of these chips are dual-core, with a clock speed of 1.3GHz. That there's such a difference in performance at the same clock speed tells you a lot about the more advanced design of Intel's chips, but if Apple were to look at putting its chips in a Mac instead of a mobile device, it could make some changes to the design, particularly since it would have to worry less about the amount of power used and heat produced. In the first instance, Apple could increase the clock speed, though this is no magic solution – increase too far and you start to get steep increases in the power needed for even modest additional gains. Some architectures are also optimized for lower-clocked operations, including Apple's.

"Apple has made some very specific design choices that will make it incredibly difficult, if not impossible, to take the A7 and run it at anything like 3GHz," says David Kanter, principal analyst at Real World Tech. He gives the example of the small memory cache on the CPU – Apple uses a cache twice the size of Intel's that's accessed more efficiently. It's a great design, but it doesn't scale up to desktop chips. Doing it





Intel has much more experience making chips than Apple, which gives it an advantage.

this way at something like 3GHz would increase the power needed for that one task – Apple has optimized for low-power, low-speed chips.

TURBO BOOST

However, a more modest increase to something like 1.8GHz is feasible, especially if combined with something akin to Intel's Turbo Boost mode, which lets CPU cores produce much higher clock speeds for short times under heavy loads. Apple could also switch to a quad-core design, doubling the number of CPU cores available, but again, this isn't quite the fantastic solution it might seem to be: it only produces significant speed increases in apps that can split their processes to take advantage of more cores.

These two improvements both carry energy use and size penalties, but these could certainly be accommodated in a laptop form factor. Of course, Apple will also be working to improve the more fundamental design elements of its CPUs, making each core more powerful even at the same clock speed.

However, while Apple is improving the performance of its chips, Intel will be bringing the energy usage of those same chips down to get that kind of performance into tablets – the opposite approach to Apple. The current MacBook Air chips use up to 15W of power, while the kind of chips in the iPad typically use more like 4W, though this can rise under heavy loads. That's a big advantage to Apple, but Intel's next generation of chips, code-named Broadwell, looks set to drop energy use by at least 30% while still offering good performance boosts. Intel has also dabbled in versions of the current generation Core i5 chips that can use just 6W of power under lighter loads, and 11.5W when under stress. This shows that Intel's performance doesn't scale down as well as its power use, with that chip only out-scoring the A7 in Geekbench benchmarks by 30%.

"Does the balance of power shift if the processor becomes less important?"

PROCESSOR PERFORMANCE

When it comes to processor performance, currently it looks like Apple could take the advantage in the balance of performance and energy use in the gap between the iPhone/iPad and the MacBook Air, but when you get into the flexibility needed to make chips that scale from phones and tablets up to laptops, Intel has huge advantages. The fabrication plants it uses to build its processors are years ahead of those Apple uses in terms of creating smaller, less energy-hungry components, and can produce components capable of running at lower voltages. By the time Apple can make its tablet CPUs start to compete, Intel will have moved on, and may be putting chips of the current level of performance in tablets.

But does the balance of power shift if the processor becomes less important? The Heterogeneous System Architecture (HSA) standard is a guide for building the kind of system-on-a-chip that Apple makes, but places a much larger emphasis on using the GPU for general computing more often, instead of relying on the CPU.

The reason is that, though the CPU is good at many tasks, it processes things serially, one step at a time. The GPU is designed to work in parallel, computing large amounts of data in intensive tasks simultaneously. It can do these kinds of tasks faster than a CPU, and much more efficiently, using less power to do the same job. Not all computing tasks will benefit from being on the GPU, but the idea is to make sure any that can be made faster by going there do so. It's unlikely that Apple will use the HSA standard exactly, but may implement many of the ideas in a similar way. Intel, being better at processors than graphics cards, is not certain that HSA is the future, unsurprisingly.

Like its processors, Intel's GPUs are more powerful than those Apple uses, but the PowerVR Series 6 GPU in the iPhone 5s is the most powerful in the mobile

market, and is designed to scale up easily. It's currently about eight times slower than Intel's GPUs, but if you used a faster version of the PowerVR Series 6 GPU, and used 20 of its clusters instead of the four in the iPhone 5s, you could match the raw computing performance of Intel's current GPUs. Apple is already taking a GPU-heavy route with the new Mac Pro, which features two extremely high-end GPUs, but only one CPU.

However, while GPU-optimized computing is great as an ideal for changing the way we think of computers, there are practical problems with trying to introduce it for OSs with long legacies, and that can hold it back as being a replacement for the CPU in more general-purpose use. "The truth is that an awful lot of code cannot be moved over to the GPU," says Kanter. "The point of the CPU is that you spend a lot of resources compensating for poor programming. A lot of the things that architects spend a lot of time creating is just there to tolerate bad code, and the kicker is that if you run bad code on a GPU, it will just run terribly."

Of course, there's the question of which OS would run on an Apple-chip-based laptop. If it ran OS X, it would have to be a new version adapted for the different architecture of Apple chips compared to Intel, and this would make the current OS X apps unavailable on it – developers would need to recompile their apps for the new type of machine, and there's no guarantee that all developers will take advantage. An alternative might be that instead of adapting OS X to run on the Apple chips, Apple could evolve iOS to include features we've come to expect and rely on, such as mouse support, true multitasking, and the ability for apps to pass information to each other. But aside from these changes, there's also the problem that iOS apps wouldn't fit the widescreen format of laptops, so it would need either some form of windowing or more flexibility in apps' layout and shape, which means more work for developers.

CASH IN YOUR CHIPS

With all of the issues of developer support and technical capabilities, and the fact that Intel will continue to create more powerful chips, you might wonder why Apple would bother doing this. One reason: cost.

Could an iPhone of the future become your computer hardware?

Intel's laptop chips cost manufacturers nearly $300. Apple's A-series chips are an estimated $30 to produce. Now, a more complex Apple chip needs to become significantly larger, and costs will increase hugely with that. But let's say that Apple were able to create a chip as powerful as what's in the current MacBook Air for around $150 – that would still make it more than $100 cheaper than an Intel one. That could allow Apple to create a new lower-priced line of MacBooks or an even smaller Mac mini starting at $500.

That said, Apple doesn't tend to introduce lower-priced options, so perhaps it's more likely that Apple would keep the MacBook Airs at their current price and include features such as Retina screens or 4G as standard, giving it a huge feature lead on the competition for the price.

All of the above, though, assumes that an Apple-powered Mac would work roughly the same as current computers do. Things may change by then. Across the industry, the cloud is starting to be used for actual computations, rather than just for storage. Apple's iCloud version of iWork does a lot of work on the server side, YouTube offers video editing through your web browser, and Autodesk already offers cloud rendering for some 3D modeling tasks. We might see the return of the 'thin client', where your computer only needs a processor powerful enough to be the interface for these apps, with all the hard work done elsewhere. In that case, even the current Apple chips might be suitable – you wouldn't need a fast computer, just fast internet.

But even that still assumes a fairly traditional form factor for the Mac. What if even the concept of what a computer is made up of has changed over the next few years? Apple has been working on technologies that make wireless connections configuration-free, and that make wireless video smooth and fast. Its iBeacons technology uses Bluetooth to let devices see when they're close to each other, and pass information back and forth appropriately, while Wi-Fi Direct is being used to establish AirPlay Wi-Fi video connections without a router. These technologies could form the basis of a system of flexible computing – your desktop computer could be simply a large-screen display with Wi-Fi capabilities, with a wireless mouse and keyboard (or whatever we use to control PCs in the future). When you sit at your desk, the iPhone in your pocket detects the setup and gives you a custom desktop on the screen using wireless video, letting you control it by using the mouse and keyboard – the iPhone becomes your computer hardware, capable of performing light tasks itself, and with heavy lifting done by servers in the cloud.

In that case, there certainly would be an Apple chip in your computer, but the Mac itself may be long gone. ■

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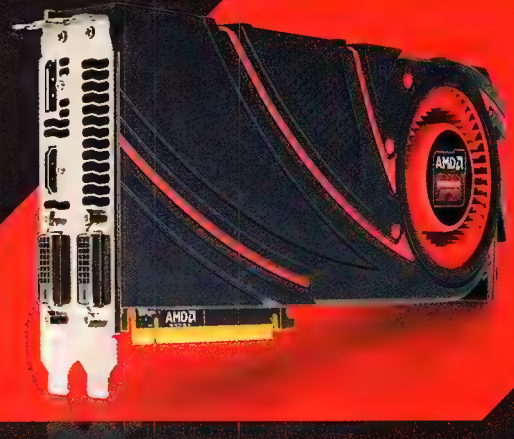

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A matching CPU socket doesn't always guarantee you can install a new CPU.

HARDWARE

CAN I UPGRADE MY CPU?

I currently have an AMD FX-6100 running on an MSI 990XA-GD55 (MS4670) motherboard with 12GB of Crucial Ballistic RAM. Can I upgrade to the FX-8350 chip using this same motherboard? I'm pretty satisfied with this system and its performance and just thought a little more chip might be in order.
Mike Hussey

This may seem like a basic question, but it's a good reminder to verify before you buy. Just because a CPU is socket-compatible doesn't mean it'll actually work on a specific board; Intel's Sandy Bridge-E X79 boards, for example, don't support Ivy Bridge-E CPUs. All motherboard manufacturers publish CPU compatibility charts on their support pages, and you should check your board's compatibility before you get that new CPU. Fortunately for you, MSI's support page for your motherboard indicates it supports the FX-8350, provided you update the BIOS.
APC staff

HARDWARE

THREE-HEADED FAN HEADER

I have an Antec Two Hundred case with a Gigabyte GA-P67X-UD3-B3 mobo. The case came with two fans (120mm and 140mm) that exhaust out the back and top. This case can handle three more 120mm fans, two in the front and one on the side panel. I would like to fill these with three fans pulling air into the case, creating positive air pressure. This may be a noob question, but how do I connect these three fans to a single fan header on the mobo? How does the APC crew connect multiple fans in a case? Is my only choice to buy a fan controller or can this be accomplished without one?
Bob Edwards

You could buy a fan controller ($30-$150), but we would probably just use a splitter cable or power distribution block. You can get two-way splitters for about $4 and three-way splitters for about $8. Just search for 'fan splitter' or 'power distribution block' on any tech-oriented store. You won't be able to control the three fans independently, of course; you'd want a fan controller for that. And depending on the fans, you may not get enough power from the mobo header to run them all at full speed, so a fan controller is probably a better option. But if you don't mind running all three fans at the same speeds from the same header, you can do that for under $6. If you want all three to run at full speed, use a Molex-to-three-pin distribution block.
APC staff

HARDWARE

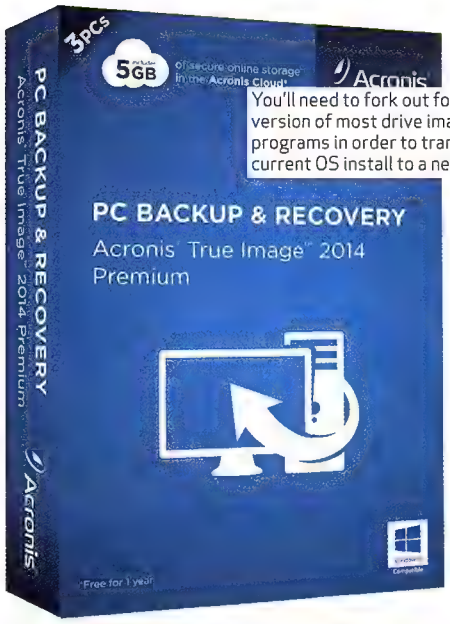
HARDWARE-INDEPENDENT RESTORE

Is there any easy way to upgrade my Core i5-2500K based Windows 7 system to a Haswell motherboard and Core i7-4770K without totally reinstalling the OS and all of my programs? I'm keeping the same Samsung 840 boot SSD and WD 1TB Raptor data drive. My old Gigabyte P67 motherboard is acting up and I ordered a GA-Z87X-UD3H, Core i7, and RAM. Can I just install all the new motherboard drivers, etc., to get it going? I heard something about Acronis having a program that help?.
David Winokur

Yes, Acronis has this feature — they call it Universal Restore, but unfortunately it's not available on the free versions. You'd have to pony up $80 for True Image 2014 Premium. EaseUS ToDo Backup Workstation has a similar feature for $40. If you don't want to pony up the dough, though, your best course of action is to suck it up and do a clean OS install.

If you don't mind taking a bit of a risk, you can try to do it manually. First, clone your boot disk to an external

Fan splitter cables are a much cheaper alternative to buying a dedicated fan controller box.



You'll need to fork out for the full version of most drive imaging programs in order to transfer your current OS install to a new PC.

If the Windows 7 USB/DVD download tool doesn't work, you can still manually create a Windows USB install drive yourself.

drive just in case something goes wrong. Next, go to Gigabyte's support page and download the drivers for your new motherboard. Extract them to an external USB drive, but don't install them yet.

Once that's done, shut off your computer and remove the data drive. Reboot into Safe Mode by holding F8 at startup, then remove the motherboard drivers in Device Manager – use the software download page for your P67 board as a checklist to make sure you've gotten everything. Then shut down again and swap in the new CPU and mobo. Fire up Windows; hopefully it boots. Install the new mobo drivers, restarting when necessary, and you should be good to go. This has usually worked for us, but your mileage may vary, which is why our preferred solution is to do a clean Windows install.

APC staff

WINDOWS

MAKING A BOOTABLE FLASH DRIVE

I am trying to make a Windows 7 bootable USB drive. I'm using the MS Windows 7 USB DVD download tool. When I get to the step where copying of files to the USB drive should start, I get this error: 'The selected USB device I:\ (Removable Disk) is in use by another program. Please close all applications and try again.'

Task Manager does not show any applications running apart from the download tool.

Johan Maritz

You might very well not have any apps open, but if you switch to the Processes tab, you'll see tasks aplenty running there. In particular, if you have antivirus software running, it may be monitoring your system for certain kinds of disk access, and this could block writing to the USB stick. One way to rule out this possibility is to run the USB/DVD download tool in Safe Mode with Networking (reboot and hit F8 before the Windows logo appears).

There's another option, though. The download tool assumes your USB stick has an MS-DOS partition table. Most new sticks come pre-formatted to FAT32 and should have the correct Master Boot Record and partition table. If you have previously used this stick to boot other operating systems, such as Linux, the partition table might be set to something odd. It could also just be corrupted. The download tool will attempt to reformat the stick, but it doesn't recreate the partition. To do that, open the command prompt and type these commands:

```
diskpart
list disk
```

This will give you a list of all the drives Windows can see, labelled Disk 0, Disk 1 and so on. Figure out which one corresponds to your USB stick, which should be obvious from the reported sizes. Now type these commands:

```
select disk #
clean
create partition primary
```

Replace the # with the correct number for this drive. Make sure you get this right because the clean and create partition commands will erase all the data on that disk. This is heee-larious if you accidentally select your hard disk. Once that's done, finish up with:

```
select partition 1
active
format quick fs=fat32
assign
exit
```

The reformat probably isn't strictly necessary, but we may as well be belt-and-braces about this, now that we've erased the drive anyway. Now re-run the download tool and you should find that it can correctly access the USB stick.

Luis Villazon

HARDWARE

RUNNING OUT OF SSD SPACE

My current setup involves a 128GB OCZ Vertex 4, one of the old 10K RPM Western Digital VelociRaptors, and a 1TB NAS in RAID 1 where all of my music, pictures, movies, etc., are stored. I've long since run out of space on my SSD, thanks to Windows 7 and Steam games, and have had to move my Steam repository to the VelociRaptor. My question is, what's my best approach to upgrade my SSD space? Should I look at getting a second Vertex 4 and doing a RAID 0 array, to get myself to a total of 256GB? Or should I look at getting one of the 256GB Samsung drives, and use that to boot from, and use the current Vertex to hold some games? Would I still get the SSD benefit if I have games that are on a separate SSD from the OS?

Aaron Vandervort

Yes, as long as the games are on an SSD you'll see faster load times. It doesn't matter whether the SSD is the same as your boot drive. We'd recommend the last option you mentioned: get a 256GB Samsung drive and keep your 128GB Vertex 4. You can either put the OS on the Samsung or move your games there, but there are no issues at all having one SSD for your OS and programs and one just for games. Several APC staffers do just that.

APC staff

If you plan on upgrading to a bigger SSD, you can still hang onto the old one and use it for games or apps.

Automate Windows the clever way

Discover how to create custom scripts so you can manage your PC the clever way.

Exploring the more advanced Windows tools is a great way to begin taking control of your PC. Learn about Task Manager, for example, and you'll soon be able to detect and close down failing processes that might be slowing down your computer.

Relying on the standard applets presents all kinds of problems, though. You have to manually launch them every time you want to do something. Then you're forced to work your way through the interface, perhaps choosing the same settings and options, over and over again. And even after all this, the applet might not do exactly what you need.

Fortunately, there is another way. PowerShell is a powerful scripting language that enables you to take full control of every aspect of your PC. Whether you need to watch running processes, monitor the file system, tweak the registry, download files, analyse web pages, create reports or do just about anything on your local PC or networked system, PowerShell can help you get the job done, as precisely as you require, and as quickly as possible.

What's more, while it can sometimes be complicated, you don't have to be a programmer to begin learning a few scripting basics. In fact, if you work at the Windows command line, even occasionally, you could be carrying out useful tasks in PowerShell with just a few minutes study.

COMMAND PROMPT

To launch PowerShell, press Windows key-X and choose 'Windows PowerShell (Admin)', or search for PowerShell, right-click 'Windows PowerShell' and click 'Run as administrator'.

As you'll see, the PowerShell interface looks and feels almost identical to the standard command line. And in many ways, this is a good thing, because it means you can use all the commands you know already. Enter `DIR` to list the files in a folder, for instance, `cls` to clear the screen, or `IPCONFIG` to list your network adapters; it works as you'd expect.

What you do get, though, is many new commands – or cmdlets (pronounced 'command-lets') in PowerShell-speak – and, fortunately, there's a cmdlet to list them all. Type `get-command` and press Enter to take a look. For now, ignore the functions and look only at the cmdlets.

As you'll see, cmdlets have a clear verb-noun naming structure: Start-Process, Clear-EventLog, Get-ComputerRestorePoint, Restart-Computer, and so on. This makes them quite easy to understand but, of course, you'll often need more detail. Enter `Update-Help` to download and install the documentation, then use the Get-Help cmdlet, like this, to find out a bit more about PowerShell:

```
Get-Help Start-Process
Get-Help service
Get-Help clock
```

The first line displays specific help on Start-Process; the second lists cmdlets with service in the name; and the third searches the help system for any items containing the word clock – great when you know what you want to do, but just aren't sure which cmdlet to use.

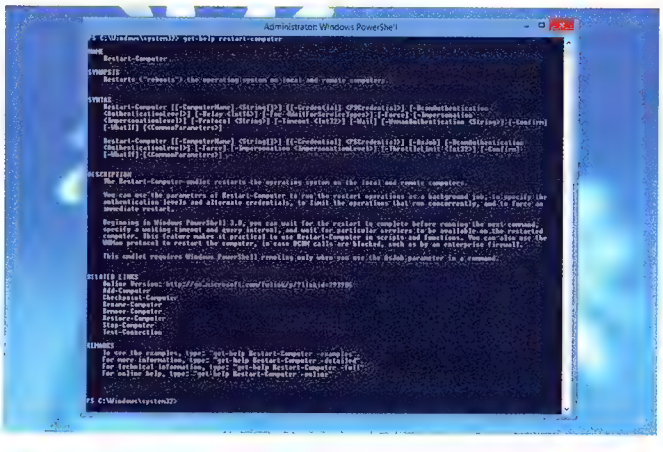
QUICK QUERIES

Enough of the theory; it's time to do some real work. Let's start by using PowerShell to collect some data on our system, like this:

```
Get-Process
```

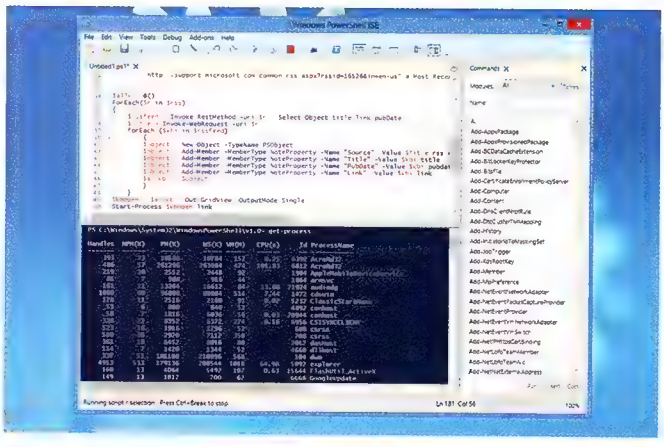
Take control of your PC

Show your system who's boss.



1 RUN QUICK COMMANDS

The PowerShell console supports all the usual Windows commands, so you'll be using it right away. But explore the Help system and you'll find new tools to control programs and services, manage network PCs, process files, access web content, and more.



2 BUILD POWERFUL SCRIPTS

Now you've mastered the basics, launch PowerShell's Integrated Scripting Environment (ISE) and use its straightforward editor to create longer, more powerful scripts. Launch them with a click, saving your favourites for easy recall at any time.

As you'll probably guess from the cmdlet name, this gets a list of processes currently running on your system (just the same as you would see in Task Manager), and displays their CPU and RAM use, along with some other statistics. That's already useful, and not something you can do easily in Windows alone, but we're just getting started. Next, enter this:

```
Get-Process | Where-Object CPU -gt 5
```

As before, PowerShell is first checking your running processes. The pipeline character tells PowerShell to pass that list to the Where cmdlet. And this scans through the process list, looking for anything that matches the condition – it should have used greater than five seconds of CPU time (-gt is greater; -ge is greater or equal to; -lt is less than; -le is less than or equal to).

We've now filtered our original list a little, then, but there's still more to do. Enter this:

```
Get-Process | Where-Object CPU -gt 5 | Sort-Object -handles -descending
```

We're still fetching your running processes and picking out the CPU hogs, but now PowerShell is sorting the remaining processes by their number of handles (a measure of how many files, memory blocks and other objects a process has open). Again, this is just an example, so tweak it; sort by CPU, say, or ProcessName (the column headers at the top of the Get-Process list will give you an idea of the names you can use).

POWERFUL REPORTS

As you can see, there are plenty of ways to customise and filter whatever PowerShell returns, but there's a problem: we're still only getting plain text results. So try this:

```
Get-Process | Where-Object CPU -gt 5 | Sort-Object handles -descending | Out-GridView
```

PowerShell doesn't only filter and sort the list; it also displays the results in an interactive grid. You can hide, re-order or sort columns, and filter your data in various ways. And once you're happy, any selected rows can be copied to the clipboard, ready for using anywhere else.

PowerShell scripts can return plain text, tables, or even display data in simple GUIs.

Not bad for a single line of code and, of course, you can have as many lines as you need, but there's more. Because PowerShell cmdlets work in such a consistent way, you can take this example and reuse it almost immediately. Take a look at these:

```
Get-Winevent System | Where-Object LevelDisplayName -eq "Critical" | Out-GridView
Get-Service | Where-Object status -eq "running" | Sort-Object displayname | Out-GridView
```

The first gets the contents of the Windows System log, looks for critical errors and displays them in a table. The second fetches running services, again sorting them to suit. And both examples can be further tweaked and customised in many different ways.

TAKE CONTROL

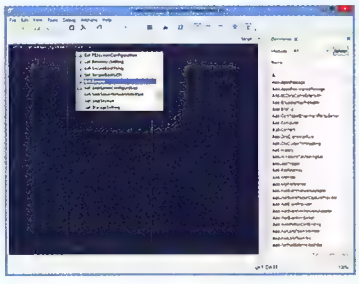
PowerShell isn't just a passive reporting tool. Take a look at this:

```
Get-Service | Out-GridView -Title 'Select service to restart!' -OutputMode Single | Restart-Service -WhatIf
```

We're getting a list of installed services, and displaying them with a custom window title as a user prompt. The -OutputMode Single switch tells

Enter PowerShell commands faster

Don't waste time typing long commands at the PowerShell console. Enter just a few characters (Get-Pr for Get-Process, say), keep pressing tab and any matches appear. Or use an alias, a shorter version of the same text; npssc works in exactly the same way as New-PSSessionConfigurationFile, for example. Enter `Get-Alias` to see the aliases you can use right now, and `Set-Alias` to create your own (**tinyurl.com/29cch6t** has some useful examples).



Speed up your coding with PowerShell aliases.

Microsoft Script Center
Welcome to the Microsoft Script Center. We are dedicated to the system administrator scripters of the world. At the Microsoft Script Center, we focus on teach Windows PowerShell to reduce time spent performing mundane tasks.
What's new?
Check out the Hey, Scripting Guy! blog to catch all the latest news, events, and, of course, scripts!
Join the conversation
The Scripting Guys forum is the place to share your knowledge and get help from other scripting fanatics.
Learn
Visit our learning center to start scripting or hone your skills.
Get scripts
Find scripting resources in the vast Script Center repository.

3 EXTEND YOUR SKILLS

Point your browser at Microsoft's Scripting Centre, and look out for interesting sample scripts. Copy and paste these into the ISE, press F5 to try them out, then read the code and try to figure out how they work — it's a great way to learn the language.

PowerShell isn't just about the command line. New-OSCWindowsTile creates tiles to launch scripts.

Top tips

Latest version

This article is based on PowerShell 3.0, as provided with Windows 8.1. Download the update (**tinyurl.com/9lnxdf4**) if you're using an earlier version.

PowerShell that we're allowed to select one item in the list. If we do this, and click OK, our chosen service is passed along the pipeline to the next cmdlet, Start-Service, which stops and starts it for us, which is a useful way to try to revive services that are misbehaving.

Or, at least, it would restart the service if we hadn't included the -WhatIf switch, which tells PowerShell to simply display its action instead. This is a handy safety option, which means you can see how a cmdlet might work without the risk of, in this case, accidentally stopping a service that really should be left alone. But if you want to try it for real, enter the same cmdlet without the -WhatIf, and you'll have created your very own custom service-restarting tool.

You can, of course, do something similar with processes, services, and any other objects PowerShell can manipulate. But even that's not the end of the story:

```
Get-Service -ComputerName MyPC | Out-GridView -OutputMode Single | Restart-Service -WhatIf
```

Cmdlets like Get-Service and Get-Process aren't restricted to your local system. Use the -ComputerName switch with the name of a network computer and you're able to see what it's running (assuming your Windows user account has the privileges to access them). PowerShell can then manage remote systems in exactly the same way as your own PC.

POWERSHELL ISE

So far we've been working only in the PowerShell console, entering commands and seeing the results right away. There is another way to run code, though – in the PowerShell Integrated Scripting Environment (ISE). It's a little more complex, but much better when you'd like to string several cmdlets together, or create some code for reuse later. Launch it by searching for PowerShell and clicking 'Windows PowerShell ISE', entering `Powershell-ISE.exe` in the Run box, or by entering `ISE` at the PowerShell console.

The ISE opens with a two-pane interface. On the left is the console, where you can enter PowerShell commands. On the right is the Commands Add-On, a tool that can help you build commands with the mouse.

Type `process` in the Commands Name box; you'll see various matching cmdlets. Select 'Get-Process' to see its parameters, helping you understand what the cmdlet can do. Click the Name tab, for instance, and you'll find a Module box. What does this do? Check it and click Run. The Commands Add-On builds the cmdlet Get-Process -Module, runs it in the console, and displays the results – a list of all your processes, where each one includes its loaded modules (DLLs and other support files).

While this can be helpful, the ISE console also has some extra tricks to speed up your PowerShell coding. Begin typing a cmdlet (try Get-Process again) and ISE displays possible matches. By the time you've reached Get-Pro, the correct cmdlet should be highlighted, and you can press Tab to automatically enter the remaining characters.

It's a similar story when it comes to entering parameters. Tap the space bar, then a hyphen, and ISE lists the various Get-Process options. Use the cursor keys to scroll down, then select '-Module', press Enter and again it is automatically added to your command.

As you can see, there's more to learn in the ISE, but it also makes it easier to explore what PowerShell has to offer. Now we just have to build a script.

SCRIPTING

Click 'View > Show Script Pane' to reveal the script pane. This is a separate area where you can enter a string of commands, across as many lines as necessary, without having them executed immediately. Instead, you can run all the commands in the Script pane at any time by pressing F5 or clicking 'Debug > Run'.

To give this a try, enter the following four commands into the Script pane.

```
$computername = read-host "Which computer name would you like to check?"
```

```
  $os = Get-WmiObject -Class
Win32_OperatingSystem
-ComputerName $computername
  $lastbootuptime = $os.
ConvertToDateTime ($os.
LastBootUpTime)
  Write-output "$computername
last boot time was
$lastbootuptime"
```

This is a simple script, which tries to find out the last boot time for whatever network computer you specify. Although short, it's more advanced than our previous code, and introduces several new concepts.

The first line, for example, uses the read-host cmdlet to display a prompt, asking the user to enter a computer name. This is then stored in a variable called $computername.

The second line uses WMI to retrieve the OS for the specified computer, while the third then obtains its boot time and converts it into a readable format. (Don't worry about the technical details here; all you really need to remember is that Get-WmiObject can return useful information about your system.)

Finally, the last Write-output cmdlet sends a message to the console. The variables will be replaced by their actual values so, for example, you might see "MyServer last boot time was 06/10/2014 08:30".

Press F5 to launch the script. If you can access a networked PC, enter its name, otherwise enter localhost or just a period to check the local system. And that's it – your first multi-line script. Click 'File > Save As' and save it as C:\Scripts\LastBootTime.ps1 (creating the folder, if necessary), ready to be recalled whenever you like.

SCRIPTING

Our sample ISE script was very small, but the principles can be used to run whatever you like. Visit the Microsoft Scripting Centre (**tinyurl.com/qzdxgud**) – or search the web for PowerShell Scripts – to locate more examples, copy and paste them into the scripting pane, and press F5 to see the results.

There is still one issue remaining, though: how can you run the script outside of PowerShell? Double-clicking it seems an obvious solution, but try this and the file opens in Notepad; less than helpful.

You could relaunch PowerShell and enter C:\Scripts\LastBootTime.ps1 at the command line, but that won't work, either. You'll just see a message complaining that "running scripts is disabled on this system". This is normal; the default security settings place strict limits on scripts to prevent their abuse by malware. To get around this problem, you need to find out more about PowerShell's execution policy. The following cmdlets will help:

```
  Get-ExecutionPolicy
  Set-ExecutionPolicy
-RemoteSigned
```

The first line should tell you that your policy is set to 'restricted', blocking scripts. If so, entering the second line sets execution policy to 'RemoteSigned', instead. This means your own scripts will run immediately, but any scripts you download will need to be digitally signed by a trusted publisher.

Test the new policy by entering C:\Scripts\LastBootTime.ps1 again, and this time your script should run. If it's too much hassle to enter the full path each time, just add C:\Scripts (or whatever folder you choose for your scripts) to your PATH environment variable (press Windows key-X, click 'System > Advanced System Settings > Environment Variables', double-click Path in 'System Variables', then add a semi-colon and the folder – ;C\Scripts – to the end of your path).

This isn't quite the end of the story. The official PowerShell library (**tinyurl.com/njo5as7**) has some useful details on executing scripts, and there's a neat trick you can use to launch scripts from a shortcut (**tinyurl.com/ptbpnr8**), but otherwise you now know how to test, write and run PowerShell code.

It's time now to begin some serious scripting. ■

PowerShell tips and tricks

Faster editing

If you need to reuse a PowerShell command, don't waste time retyping it. Press F7 to view your recent history, select a command, press Enter to run it, or the right arrow to place it on the command line. See **tinyurl.com/qyovam2** for more editing shortcuts.

Use comments

Adding comments to your PowerShell scripts will help others understand what they do (or act as a reminder for you). Type a # character and whatever you enter for the rest of that line will be treated as a plain text comment and not be processed as code.

Access Control Panel

PowerShell can access Windows components, as well as files. Use `Get-ControlPanelItem` to get a list of Control Panel applets, and something like `Show-ControlPanelItem *display*` to launch one.

Record a PowerShell session

Reviewing what happened in a PowerShell session can help the learning process. Enter the cmdlet `Start-Transcript` and all your console activities (including any output) are saved to a text file in your Documents folder. Enter `Stop-Transcript` to stop recording.

Scripted downloads

Need to download a file from a script? This is the easy way (see **tinyurl.com/pdpvhdo** for something smarter):

```
  $client = New-Object
"System.Net.WebClient"
  $client.
DownloadFile("http://domain.
com/bigfile.zip","c:\temp\
bigfile.zip"
```

Send email

You don't have time to monitor everything your scripts are doing? You could set them up to send you an email, instead. Check the Send-MailMessage cmdlet for a basic example, or Peter Morrisey's blog (**tinyurl.com/psu8wl4**) for something more powerful.

Get examples

If you're not sure how to use a cmdlet, use the Get-Help -examples switch, such as Get-Help Invoke-WebRequest -examples, to learn more.

RSS reader

The Invoke-RestMethod cmdlet can access the RSS feed and manipulate it however you like. Here's a quick way to view what's happening in Microsoft's PowerShell blog:

```
  Invoke-RestMethod -Uri
http://blogs.msdn.com/
powershell/rss.aspx |
Select-Object Title, Link |
Out-GridView
```

Process files

To process text files, use Get-Content to read them, manipulate the content how you want (see **tinyurl.com/bwpepeu**) and use Set-Content to save changes. Mistakes could result in lost data, though — only work with copies of files until you're sure you know what you're doing.

Run scripts automatically

If you become a PowerShell master, you could even set up Task Scheduler to run scripts automatically, whenever you like. Read up on the New-ScheduledTaskAction, New-ScheduledTaskTrigger and Register-ScheduledTask cmdlets, and see **tinyurl.com/pgaanez** for an example.

Remote music streaming with Linux

With music files scattered over various devices, Neil Bothwick uses Subsonic to try to bring some order to the chaos of his audio library.

Subsonic is a web-based media streamer, it runs as a service on the computer holding your music and you can then play it on other devices connected to the server. Although it does play video files, its main focus is as an audio streamer and that is what we will look at here. Through its web interface, Subsonic provides the usual features: playlists, cover art, lyrics and so on. The server can handle multiple connections, you can listen to different tracks in different rooms, or even while out of the house.

Subsonic is written in Java. If your package manager includes a recent version, install it in the usual way. Otherwise, use the standalone archive. We are using subsonic-4.9_beta2-standalone.tar.gz, although the full 4.9 release may well be available by the time you read this (which is why we are not using 4.8). Before installing from the archive, make sure you have a Java Runtime Engine (JRE) installed – either Sun Java or the open source IcedTea variant. The archive does not have all its files neatly in a directory, so you need to create one.

```
sudo mkdir /opt/subsonic
sudo tar -xf subsonic-4.9_beta2-standalone.tar.gz -C /opt/subsonic
```

There is no hard and fast rule as to where Subsonic should be installed, but /opt is the standard location for miscellaneous programs such as this. You could even install to your home directory if you only wanted to run it as one user. We need to create a user to run Subsonic and a home directory for them:

```
sudo useradd --home /var/subsonic --create-home --user-group subsonic
```

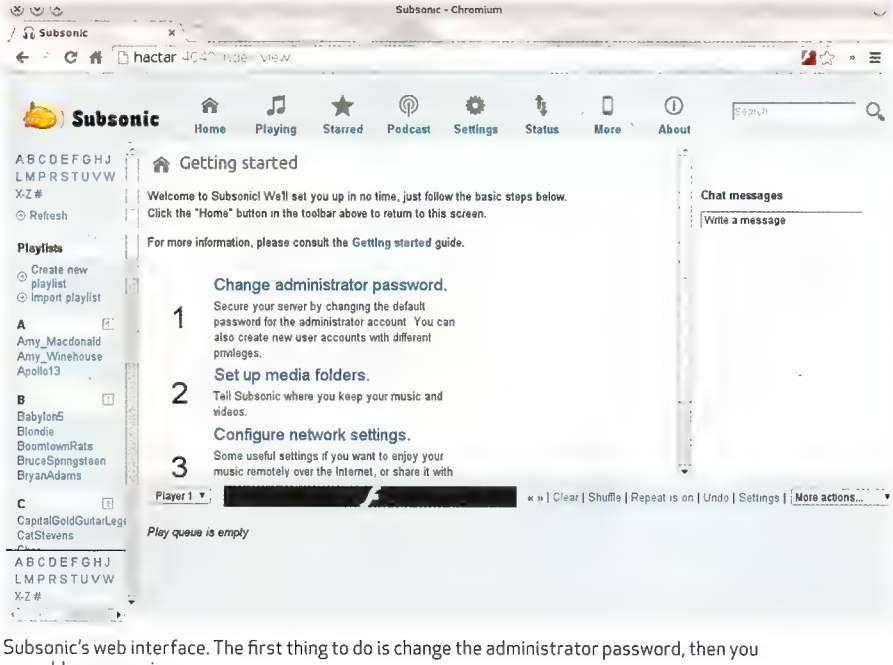
You also need to add some transcoders. Subsonic uses these to transcode audio formats on the fly and you will not get far without them. The embedded browser player doesn't even play Ogg Vorbis files, so these need to be transcoded to MP3 before playing. Subsonic uses standard tools, such as ffmpeg, for this, but it doesn't search the system for them – we need to link them into Subsonic's transcode directory:

```
sudo mkdir -p /var/subsonic/transcode
cd /var/subsonic/transcode
sudo ln -s $(which ffmpeg)
sudo ln -s $(which flac)
sudo ln -s $(which lame)
```

It goes without saying that you should ensure these tools are installed, you'll find that most distros will already have them in place.

CONFIGURING SUBSONIC

If you installed from your package manager, it should have added an init script to start Subsonic when you boot. If you use the standalone archive, there's a script at /opt/subsonic/subsonic.sh (assuming you installed to /opt/subsonic as above). Edit this script to set the paths for your default folders, then run it to start the Subsonic server. Then open your favourite browser and point it to **http://localhost:4040**, at which point you will be instructed to change the admin user's password from the



Subsonic's web interface. The first thing to do is change the administrator password, then you can add some music.

Added features for a buck

Get more with a premium account.

Subsonic offers a premium service that enables certain features: such as remote access through your own **user.subsonic.org** address; ability to use mobile clients to listen to music from outside of your network; podcast downloading and more. This costs US$1 per month, as it uses their servers, but is free for the first month. If you are feeling creative, you can implement many of these features with the free version by using facilities such as a dynamic DNS service and a VPN. On the other hand, a dollar a month saves you the trouble and contributes towards further development of Subsonic.

default of admin. Until you do this, anyone with access to your network can log in to Subsonic with administrator rights, so do this right after starting Subsonic for the first time. Note that if you are running Subsonic on slow hardware, it can take quite a while before the web server is available on the first run, more than a minute when we tried it on a Raspberry Pi.

Once you are logged in, you will see all the music from the default folder you set. To add more folders go to 'Media Folders' on the Settings page. Subsonic does not use ID3 tags to sort your music, although it does use them to display information; the listing of your music is based on the location of files in the filesystem. This works best if you have your music organised in an artist/album/track hierarchy.

The transcoders we just set up are not only used to convert between formats, they can also be used to alter the bit rate of streams. This is important when serving to remote clients, especially if the upstream bandwidth from your server is limited, or when the remote clients are using 3G data connections. This way, you can store your music in high-quality formats for the best local playback, but still listen to them on the go.

The default mode of operation is to access Subsonic via a web browser, which includes a flash-based player. From here, you can browse the available tracks, create and play playlists, download individual tracks or entire playlists and do most of the other things you would expect of a music player.

It is also possible to use an external player, either because you want extra features or don't want to use flash. This works by creating a playlist in standard M3U format and sending that to the player. The external player then gets the files from the Subsonic server to play. This means it should work with any music player that supports M3U playlists. However, it doesn't work with the Chromium browser, which tries to save the playlist rather than trying to open it. Firefox defaults to passing the playlist to your preferred media player.

Because you are able to set up multiple player profiles on the Settings page, you can have one to use the built-in player and another to use an external program. You can also use this page to set up players with bitrate limits, for use over slower network connections.

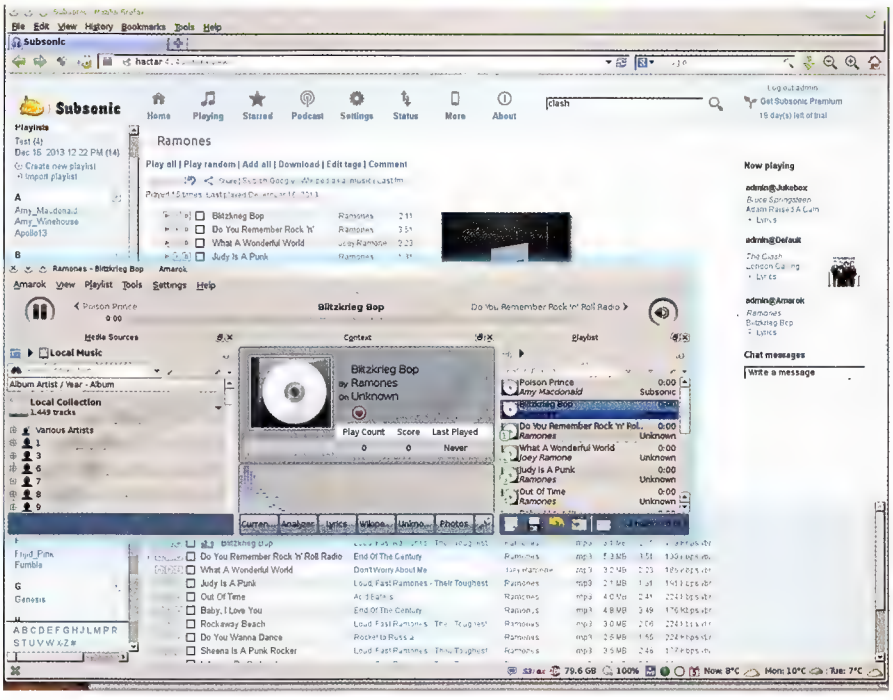
REMOTE ACCESS

While you can use Subsonic from any computer on your network, it is also possible to access your music collection from elsewhere on the internet. To do this, you need to set up forwarding from your router to the computer running Subsonic. You can do this from the web interface if your router supports UPnP, otherwise you simply forward the relevant port – 4040 by default. If you have the Premium service (see 'Added features for a buck', left) you will have your own **subsonic.org** address that avoids the need for a static IP address or dynamic DNS service.

There are apps for most mobile OSs, or you can use a browser. The premium service is also needed if you want to use the Android app to play your collection, even when connected by Wi-Fi to your local network. You can, however, play from a browser or something like Bubble UPnP Player with the free service, provided your server is accessible from the internet and you have a contactable public address.

Subsonic also has a podcast fetcher: give it the URLs of the feeds of your favourite podcasts and it will grab new episodes as they become available. This is a Premium feature, though. Alternatively, you could use something such as FlexGet to download the podcasts and drop them into Subsonic's podcasts folder.

> "The premium service is also needed if you want to use the Android app to play your collection, even when connected by Wi-Fi to your local network."



Don't like the web interface? Dislike using Flash players? Subsonic can send your songs to any player of your choice.

LEVELS OF USERS

The first user, the one who set up Subsonic, is able to create users, with quite fine-grained permissions. Click Settings from the top menu and go into users, where you can set the popup menu to New user. Then you can decide what that user is able to do. The default for a new user is to only allow them to play files. You can add permissions to download or upload files, comment and rate songs, share songs with others etc. You can also set the maximum bitrate for each user, which is important if you have a few users, particularly those likely to access the service remotely at the same time, as they could use a lot of your upstream bandwidth.

Subsonic usually operates as a classic client/server model, where the server sends the music and the client plays it. It also has a Jukebox mode, only available to users with suitable privileges, where the music is played on the server. If you have the server running on your living room PC, you can use a mobile client, or any other PC, to control it. Jukebox mode is controlled by the player settings on the web client or via touching the RC button on the Android client. ■

Tags 102

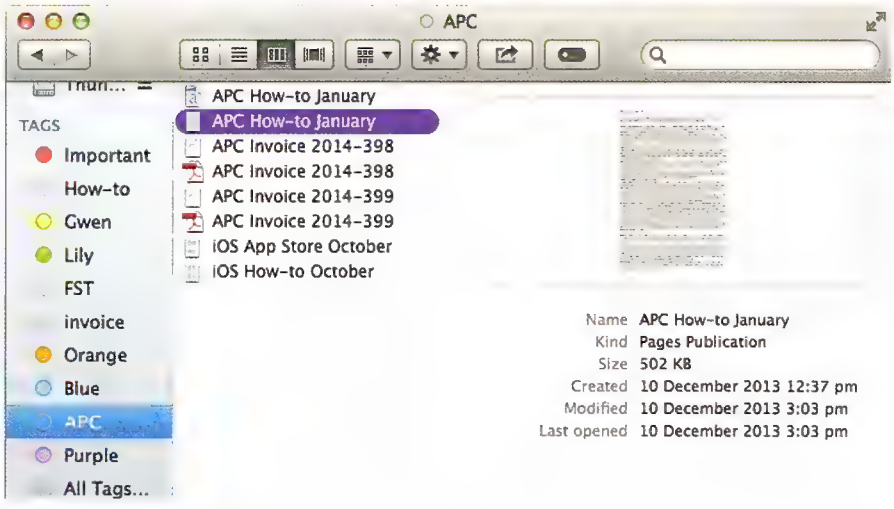
Having introduced the wonders of tags in Mavericks, Matthew JC. Powell shows you how to unleash their full potential.

A couple of issues ago, we covered the basics of Mavericks's tag system: how tags differ from the older Labels, and how (and why) you can and should add them to your files. Basically, the Mac file system as we have known it is becoming a thing of the past: between sandboxing (files being associated with and visible to only the applications that created them) and the flat filing systems of iOS and iCloud, your old ways of keeping track of files are rapidly fading.

Tags overcome this by extending the metadata on files so that, wherever they happen to be located, and whatever application created them, they can still be found when needed. Which is not to say that tags are replacing folders, or that they will any time soon – on the Mac, at least. The best way to use tags is in conjunction with folders, rather than against them.

For example, if you have a habit of creating a folder for each month's projects (as we in the monthly magazine business are wont to do) there's little value in creating a new tag each month instead. You'll just end up with dozens and dozens of tags to keep track of. Instead, decide which criteria you're using folders for that may in fact be better suited to tags. A freelancer, for example, may decide to use tags instead of folders for names of clients. Then you can keep the files associated with that client (documents, invoices, whatever) in with the rest of your documents rather than separated out.

A bit of planning rather than just going tag-crazy will save you time and hassles later.



Tags make it extremely easy to find the files you're looking for. Just click on a tag in the Finder sidebar.

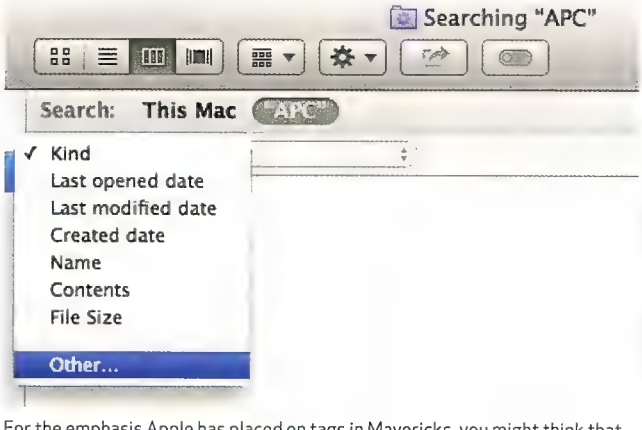
FINDING TAGGED FILES

In any Finder window, you'll see a list of the tags you've created in the sidebar at left. (If you don't see the sidebar, go to the View menu in the Finder and select 'Show Sidebar'.) Tap on any of those tags, and the window will display only files that contain that tag – it's as simple as that.

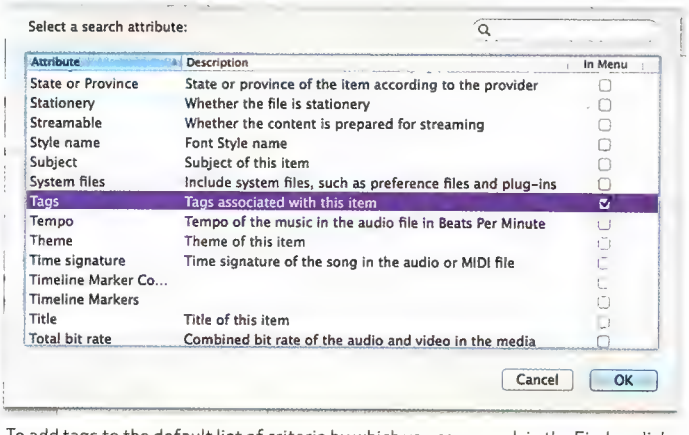
If you have files with multiple tags on them, it's only ever so slightly more complicated. Press Command-F to open a Find window (looks just like an ordinary Finder window but has some extra bits and pieces) and choose whether you want to search throughout your Mac or just in one folder. The latter can be useful if, for instance, you just want to search your Documents folder and don't want a lot of superfluous results like images.

Then, click where is says Kind – that's the default criterion for searching in this way, but not much use to us here. A drop-down menu appears with a number of other criteria you can use. Unfortunately, tags is not one of them – at least not yet. Click on 'Other ...' at the bottom of the list, and a window will open with a huge number of other criteria by which you can search. Most of these are quite specialised ('Time Signature' for example), but in amongst them is tags. If you want to include searching by tag as a default criterion, just tick the box on the right-hand side of this window.

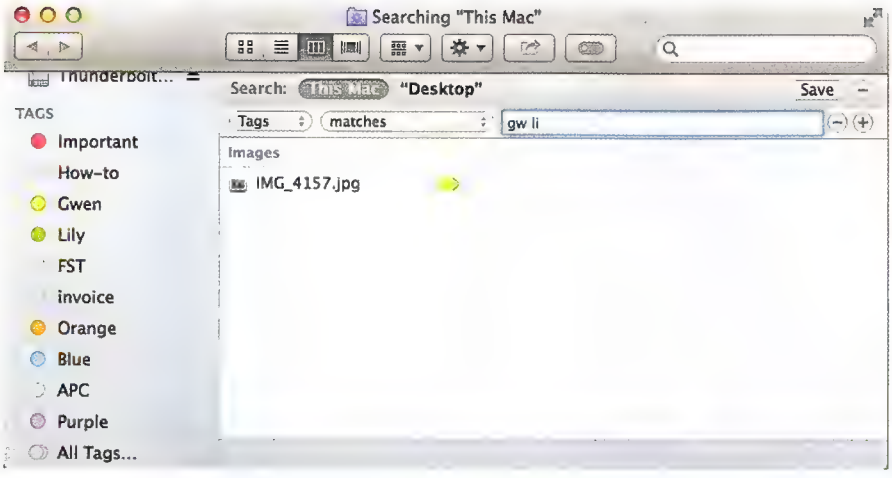
Once you've chosen to search by tag, just type the name of the tag you want



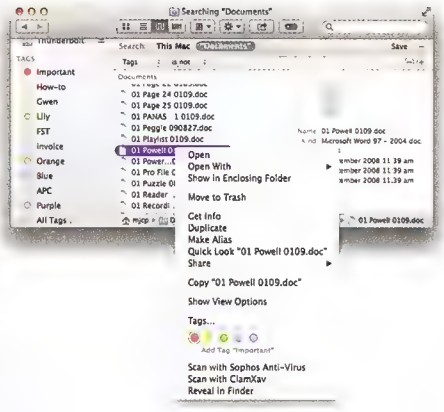
For the emphasis Apple has placed on tags in Mavericks, you might think that tags might be one of the default criteria in a Finder search. Instead, you have to click on "Other ..." and scroll through a list to search by tags.



To add tags to the default list of criteria by which you can search in the Finder, click on "Other ..." then scroll through to find tags and click on the checkbox on the right-hand side.



On of the great advantage of tags over Labels is the ability to apply multiple tags to a single file.



You can use Spotlight to search for tagged files, but you have to tell it explicitly to look for tags — it won't do it by default.

to search on in the text field. Note that you only have to type as many letters as are required to make your tag unique — the first couple of letters will generally suffice, unless you use the condition 'is' instead of 'matches'. If you want to add another tag to filter your results more finely, enter a space and then the name of your next tag — only files matching both of those tags will appear in the window.

FINDING UNTAGGED FILES

Most likely you have a great many files on your Mac already that have not been tagged — unless Mavericks is your first experience of the Mac, this is certainly the case. Tagging files as you create them is easy, as is adding tags to files as needed. But what if you want to integrate tags into your workflow in a big way, and add your tags to your old, untagged files?

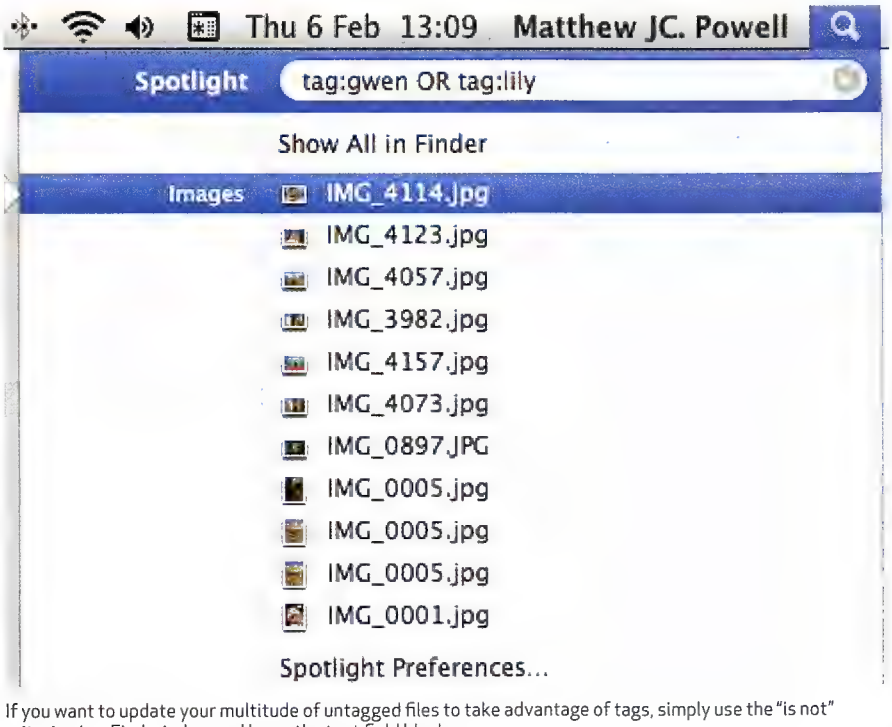
> "Many people get confused when they use Spotlight to search for tags, because it doesn't search for them by default."

Using the same method as above, open a Find window, choose where you want to conduct your search, and choose to search by tag. Then, click on the button that says 'matches' and, from the pull-down menu, select 'is not'. Then leave the text field blank.

Presto — only files that contain no tags will appear in the window. As you tag them — using any of the methods described last time, or simply by dragging them onto the tag names in the sidebar — they will disappear from the search window.

Obviously you can use the same technique to exclude particular tags when searching — so you can look for images that are not tagged 'Important' for example. Bear in mind that when excluding tags, typing only the first few letters doesn't work, since a tag called 'Important' is not a tag called 'Imp' — to exclude 'Important' you have to type the whole word.

Note that it's a good idea to filter searches like this by first searching by Kind or some other criterion — otherwise you could end up with many thousands of files to sift through.



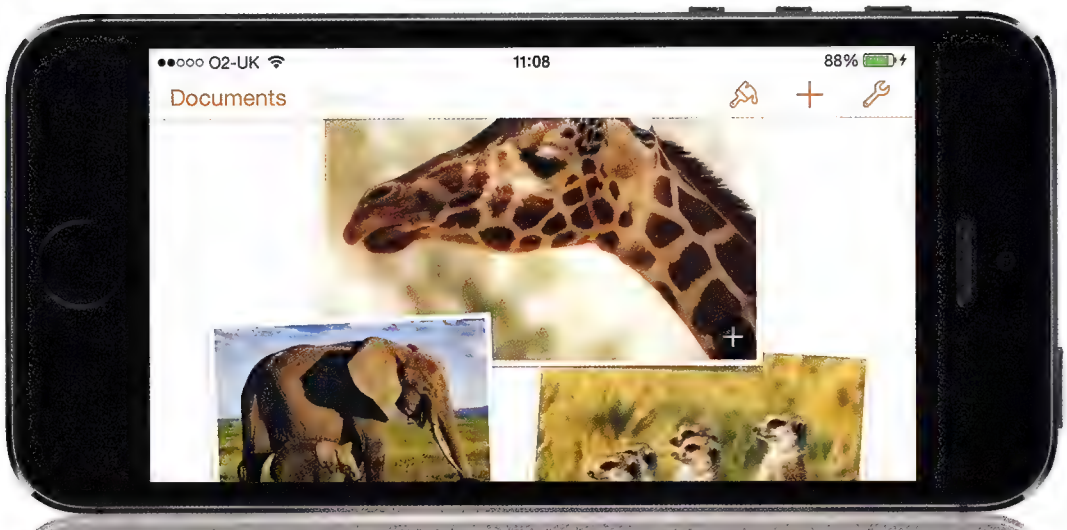
If you want to update your multitude of untagged files to take advantage of tags, simply use the "is not" criterion in a Find window and leave the text field blank.

FINDING TAGS USING SPOTLIGHT

Many people get confused when they use Spotlight to search for tags, because it doesn't search for them by default. Spotlight searches files according to their name and their content, not their metadata. If you want Spotlight to look at the kMDItem UserTags attribute, you have to tell it explicitly to do so.

Thankfully, that's pretty easy. In the Spotlight search field type `tag:tagname` (obviously replacing tagname with the actual name of your tag). You can search for files with multiple tags by typing `tag:tagname1 tagname2` to find files with both of those tags. If you want to find files with either of those tags you have to do a Boolean search — type `tag:tagname1 OR tag:tagname2`. Don't forget to put the tag: operator before the second tag, because the OR operator makes Spotlight forget that it's searching in the metadata.

There doesn't seem to be a way to find only tagless files using Spotlight, but frankly that wouldn't be very useful anyway. ■



Mastering Pages for iPhone

Powerful publishing on the move is now even easier with Pages.

With iOS 7, all the iWork apps have been given a makeover, and for owners of new iOS 7 devices all three core apps are now free, too.

Pages for the iPhone ought to be an app that's just too cramped to be effective, but Apple's design shines through this app and it's a brilliantly intuitive document creation and editing tool. Creating documents on your iPhone is very straightforward, largely, thanks to the templates available and the rather effective use of touch.

Pages on iPhone used to work only in portrait mode, which was fine if you wanted to use it just to write letters or create A4 posters, for example, but otherwise limiting. In the latest iOS versions, it can be used in both portrait and landscape mode, making it much more flexible.

HELPING HAND

There's also plenty of room for creativity, too. Start by choosing one of the 65 available templates and then customise it until it fits the bill precisely. Don't like the headline typeface? Change it. Size and colour? You can change those too. Images can be replaced with photos from your Photos app, and there are dozens of shapes to choose from to add to documents. We particularly like the image masking feature – which enables you to easily choose which part of an image to display in a box and mask out the rest – and the implementation of Arrange for choosing how to stack image boxes.

STYLES AND OPTIONS

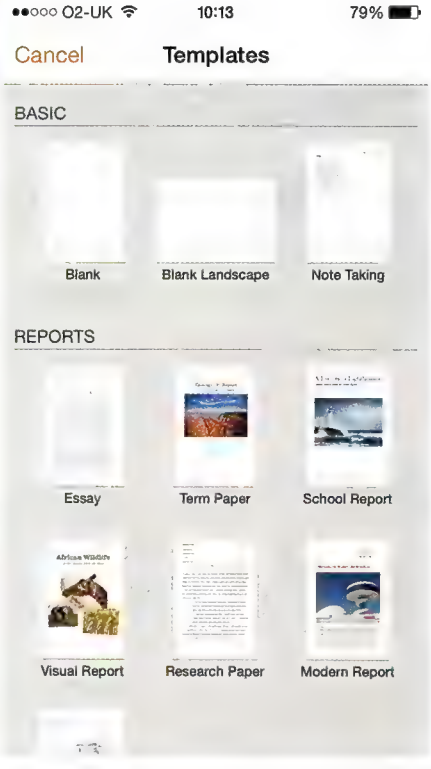
The range of style options for objects is huge, too: you can choose from preset borders or create your own. There are, for example, four different drop-shadow options, and reflection and opacity sliders for fine control. Images can have text wrapped around them and can be fixed so that they don't move with text. Formatting is excellent, too. When you're done creating a document, you can print it if you have access to an AirPrint compatible printer, save it to your iCloud or other WebDav volume, send it to iTunes or share it via email.

> "When you're done creating a document, you can print it if you have access to an AirPrint compatible printer, save it to your iCloud or other WebDav volume, send it to iTunes or share it via email."

There's no doubt that Pages on iPad is much easier and more fun to use than the small-screen version, but the Retina display on the iPhone 5/5s/5c means that with a little practice you can create and edit new documents very effectively.

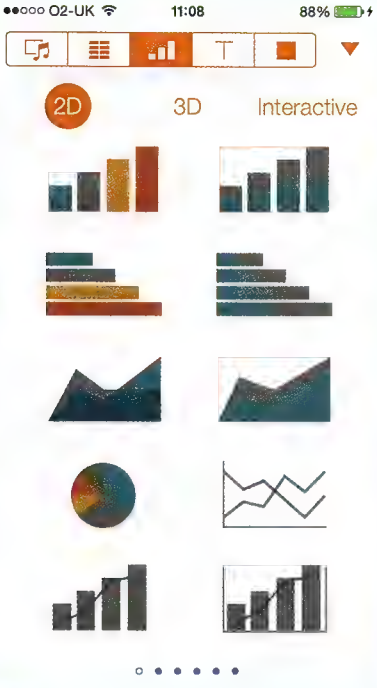
UPGRADE NOW

If a document has been created in the pre-iOS 7 version of Pages (or Keynote or Numbers), you'll be shown a notification alerting you to the fact that it has to be converted. To open it on a Mac you will need to upgrade to OS X 10.9 (it's free).



Get more out of Pages

Learn how to use all of the features.



1 SELECTING TEXT

It's not immediately obvious how you select text in Pages, where you're working with a lot of words. It's a little like using a mouse: you can double-tap to select a word, or triple-tap to select an entire paragraph at once. If you want to select all the text, you can either tap and hold, then choose 'Select All' from the pop-up menu that appears, or you can press Command+A on a paired Bluetooth keyboard. If you want to adjust the initial selection to select more or less than you'd originally defined, just tap to grab the blue handles at the start or end of your selection and drag forwards or backwards with your finger.

2 USING THE SPELLCHECK

Misspellings are shown with a dotted red underline. To correct them, double-tap on the typo, then tap Replace and pick the correctly spelled word from the suggestions. If there's only one available suggestion, you'll be shown this as soon as you tap on a word, and can tap it to accept the correction. It will also tell you if there is no replacement available.

3 UNDOING TEXT ERRORS

Sometimes you'll move an image accidentally or make a mistake while you're typing. This can be easily fixed in the iPhone version of Pages by simply shaking your phone and then selecting either Undo or Redo, as appropriate. If this doesn't work, make sure you've tapped Done or finished your current task and then try shaking your phone again.

4 ADJUST PAGE MARGINS

To adjust the size of your document you can manipulate the page margins using the ruler. To show the ruler, tap the spanner icon at the top and then tap on Ruler. To align your text, set tab stops along the ruler to align text on the left, right, centre or decimal point. Tap to place the insertion point, then drag the icon for the tab stop until it's in the correct position. You can insert as many tab stops as you want and then hide the ruler from view by simply tapping Done. If you need it, a complete list of all the tab stop icons is available in the Help menu.

> "If you want to select all the text, you can tap and hold, then choose Select All from the pop-up menu, or you can press Command+A on a paired Bluetooth keyboard."

5 GETTING A NEW PAGE

Sometimes, Pages pretty interface can be irritating. A case in point: you could spend ages trying to work out how to get the application to create a new page for a multi-page document, when in fact the command is hidden. With the keyboard showing, tap the empty space until you get the Select, Select All, Paste and Insert options. Tap Insert and there you have it — all the options you need: Tab, Page Break, Line Break and Column Break.

6 SKIM THROUGH LONG DOCUMENTS

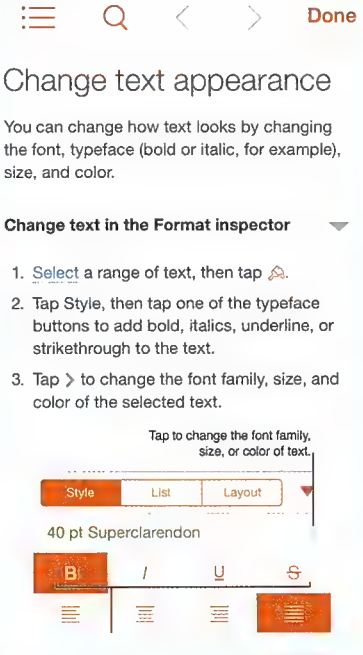
Even with the iPhone's handy flick gesture, it could take you a long time to scroll through a big document in the Pages app. Happily, Apple has you covered: tap and hold for a split second at the right of the screen, and up pops the navigator. Slide your finger slowly up and down the screen, and you'll see the pages stream past in the magnifying glass under your fingertip — the documents are displayed as thumbnails, so it should be easy to identify the page you're looking for, and there's a page number on the right too. Let go and you'll be moved to the exact page that you've selected.

7 CROPPING PICTURES

If the picture you want to use is the wrong shape for your layout, you can use the 'Edit Mask' command under the Image tab in the Paintbrush menu. This enables you to crop images, as well as zooming and panning the picture inside the mask you define — it's a bit like moving a huge poster around outside a window, except that you can alter the size of the window… and the size of the poster too, actually. Tap on the image and then the Paintbrush icon to try it.

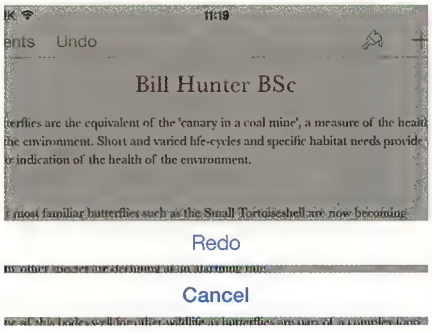
8 ANCHORING IMAGES

As in any desktop-publishing suite worth its salt, you can anchor images and shapes so that they move with the text — this is usually referred to as an inline image — or float above the text, with the option of wrapping text around the graphic. Insert your image, and then tap the Paintbrush icon. Tap 'Arrange > Wrap', and configure your anchor and wrap options from there (a little diagram helps describe the effect).


Done
Change text appearance
You can change how text looks by changing the font, typeface (bold or italic, for example), size, and color.
Change text in the Format inspector
1. Select a range of text, then tap
2. Tap Style, then tap one of the typeface buttons to add bold, italics, underline, or strikethrough to the text.
3. Tap > to change the font family, size, and color of the selected text.
Tap to change the font family, size, or color of text.
Style
List
Layout
40 pt Superclarendon
B
I
U
S

Go even further with Pages

Make sure you're using it to its potential.

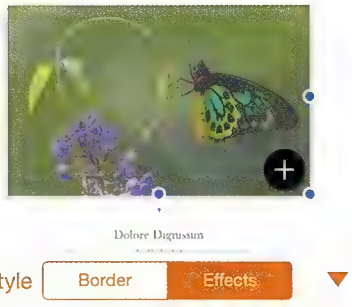


1 UNDO/REDO

If you've spent ages typing out a long document only to delete a section by mistake, or if you've simply mistyped something, you'll want to be able to undo. You get an Undo button in the top-left, or you can simply shake the iPhone to bring up the Undo option.

2 ADJUST MARGINS

While in your document, tap the Spanner icon and choose 'Document Setup'. The view will change to vertical and display the margins. Adjust these by tapping and dragging the arrows. Alter the paper size by tapping 'Change Paper Size' at the bottom of the screen.



3 IMAGE WATERMARKS

To turn an image into a watermark, add the image you want to use, then resize it to fit the area, tap the Paintbrush icon and choose 'Style Options' (Style tab). Now drag the opacity slider down to the level you want. Options for Shadow/Reflection are above the slider.

4 CREATE TAB STOPS

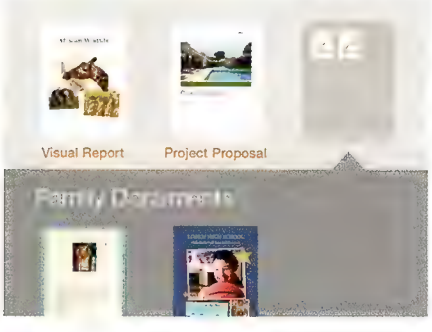
Bring up the ruler from Tools (Spanner), select the text you want to adjust, then tap along the ruler to insert tab stops. Double-tap the icon to change tab type: a diamond indicates centre-aligned, a triangle pointing left is right-aligned, a circle is decimal-aligned, etc.

5 HEADERS AND FOOTERS

Open your chosen document, tap the Spanner icon and then choose 'Document Setup'. At the top and bottom of the page you can type in the little boxes. Type your text and you're done. This adds it to the Section Master so the header/footer appears on every page.

6 PAGE NUMBERS

To add page numbers, follow the same route as for headers and footers, but when you tap on either the header or footer bar, select the 'Page Numbers' tab that pops up at the same time as the on-screen keyboard. Select the numbers from the menu and then tap Done.



7 TIDY UP

You can group documents into folders and arrange by date or by filename. In the documents view, tap Edit and then tap to select the documents you want in a folder. Tap and hold one until they all merge, then drag them over another document you want.

8 FIND TEXT

Tap the Spanner icon, select Find and a Search bar will appear on the page. Enter the text you want to search for and it will be highlighted. Tap the Pencil icon on the left and you can also do a find/replace of words in the text of your Pages document.

Import attachments

You don't have to use iTunes and laboriously sync to get documents into Pages on your iPhone. You can import Pages or Microsoft Word documents by sending them as an attachment in an email. On receipt of the email, simply tap-and-hold the file's image in the email message and select 'Open in Pages' from the options that pop up. ■

Create user defined functions in Excel

Helen Bradley explains how to create your own functions and install them in Excel.

Get it

Download the macro you need for this article from **www.apcmag.com/magstuff.htm**

If there is no built-in function for a specific calculation in Excel, you can create your own user defined function. Once created you can install it as an Excel add-in so it is available to you anytime you launch Excel.

CREATE THE FUNCTION

To create a function, open a blank Excel worksheet and choose the 'Developer tab > Visual Basic Editor'. Choose 'Insert > Module' to add a new module and type the function code into the module.

Our sample function calculates the cost of an order and would replace a lookup table or nested if function in a worksheet. It calculates the price of goods based on the quantity of items being purchased. The higher the quantity, the smaller the item cost.

```
  Function orderCost(Quantity
As Integer)
      If Quantity > 0 Then
      Select Case Quantity
          Case 0 To 10
              orderCost =
Quantity * 100
          Case 11 To 20
              orderCost =
Quantity * 90
          Case 21 To 50
              orderCost =
Quantity * 85
          Case Else
              orderCost =
Quantity * 80
          End Select
      Else
          orderCost =
CVErr(xlErrValue)
      End If
  End Function
```

> "Our sample function calculates the cost of an order and would replace a lookup table or nested if function in a worksheet."

PARTS OF A FUNCTION

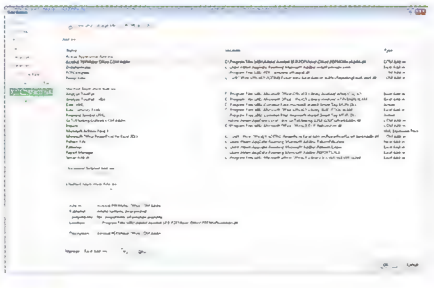
A function is prescribed by a set of 'Function... End Function' statements. It returns a value to a worksheet so it must contain at least one line which assigns a value to the function's name – in our case orderCost. It may also take arguments – our function has one argument – Quantity – which is the number of items.

Once you've typed the function, save the worksheet by choosing 'File > Save As' and from the 'Save as Type' list choose 'Excel Add-in (*.xlam)'. Call the file orderformulas and click Save. Saving as an .xlam file not only creates an add-in file but it also places it in the correct folder on your computer.

Follow the steps below to install the add-in into Excel. Once this is done the function will be available to all worksheets. You can share the .xlam file with others too. If they save the file to their Excel add-ins folder, which is typically users\<user name>\AppData\Roaming\Microsoft\Addins they can install it into Excel and have access to the functions in the file too.

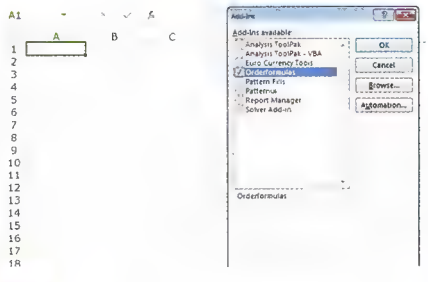
Install the add-in

Add the function to Excel.



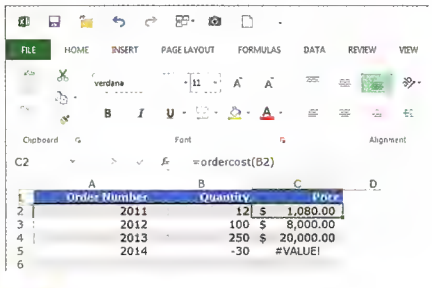
1 INSTALL

Before you can use the formula you must install the add-in file in Excel. Choose 'File > Options > Add-Ins' and select the 'Manage: Excel Add-ins' option from the foot of the dialog. Click Go.



2 LOCATE

Find the entry for Orderformulas in the list, select its checkbox and click OK. Now the functions in the file will be available for use in the same way as Excel's own functions.



3 TEST

Type a value in cell A2 and type the function =ordercost(A2) in another cell. The function should return the price depending on the number of items you typed in cell A2.

Ultimate Tasker guide – part 3: using data from the web

Tasker for Android becomes really powerful when you start feeding external information to it. Simon Chester shows you how.

In previous issues, I introduced you to my favourite of all the Android apps – Tasker. I walked you through the basic ideas and language, and got you thinking about the different contexts in which it could help you. Then I taught you how to use variables to improve the way that Actions were performed.

Hopefully, you've now created some context-sensitive 'smart' tasks using variables, but you might be wondering how you can use variables as more than just 'flags' in your tasks. Well, Tasker can also pull data from webpages and then act on that data accordingly. For instance, when your alarm sounds in the morning, you can have Tasker pop online to find today's maximum temperature and warn you if you should grab a jacket or not.

At the very heart of this is the Tasker Action 'HTTP Get'. This allows Tasker to query any webpage, and pull down its source code to be parsed and have its useful info extracted. The data that is pulled by HTTP Get is stored in the in-built variable %HTTPD.

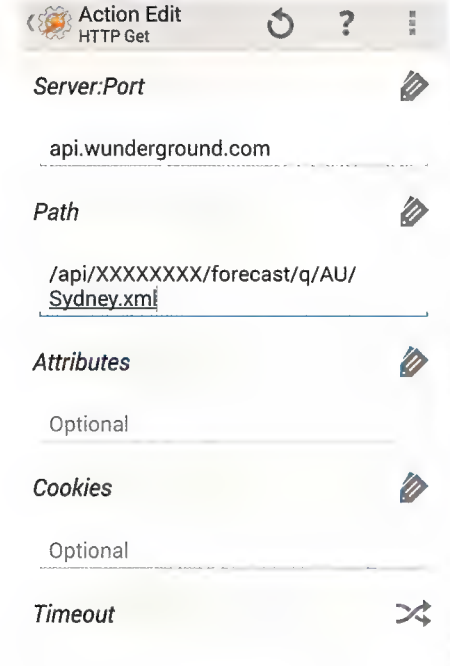
To extract the data that you need from %HTTPD, you can't just run a search – you need to split it into different variables using a number of strings. We do this by using the Variable Split Action.

But, first things first: let's find some weather data to work with.

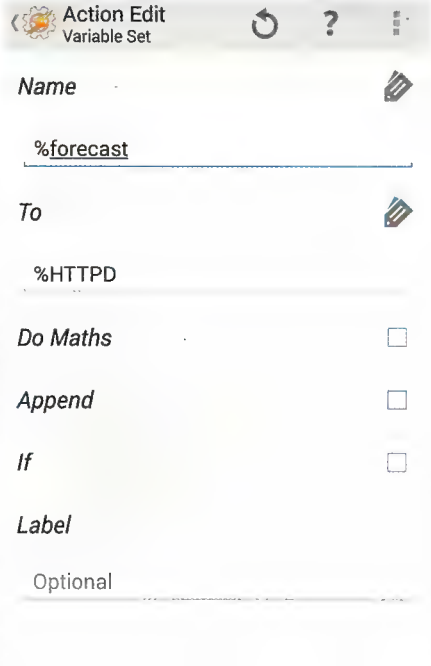
Given the requirement of later splitting the info, I find it easier to pull down an RSS feed or other XML file, rather than a standard webpage, as these contain usefully tagged elements. My preferred feed is from Weather Underground, as they supply an API for just this purpose. However, you need to sign up for a free account. If this doesn't appeal to you, try your luck with an RSS feed, e.g. **rss.weather.com.au/nsw/sydney**.

So, first things first, sign up for an API key at **www.wunderground.com/weather/api/**. Then, simply specify a project name, verify your email, and make note of the key they gave you.

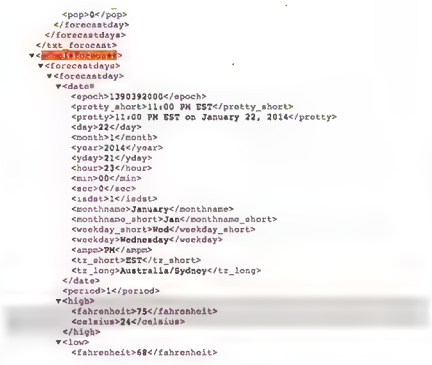
Next, open Tasker and create a new Task – I named mine 'Forecast.Get' – and add an HTTP Get Action. In the 'Server:Port' section, type `api.wunderground.com` and in 'Path' type `/api/XXXXXX/forecast/q/AU/Sydney.xml` (or Melbourne.xml, or another suitable URL from **www.wunderground.com/weather/api/d/docs?d=data/index**), making sure to replace XXXXXX with your API key.



One of the most useful features of Tasker is its ability to pull info from the internet.



Write the dynamic %HTTPD to a local variable to prevent unwanted changes.



Looking through the supplied XML file, we can find the data we need.

Running this task will now populate the in-built variable %HTTPD with the data seen at **api.wunderground.com/api/XXXXXX/forecast/q/AU/Sydney.xml**. In the next step, we will parse this data for the info that we're interested in: today's max temperature. This is a fiddly process, so I recommend opening up the XML in your PC's browser, so that you have an easy reference point.

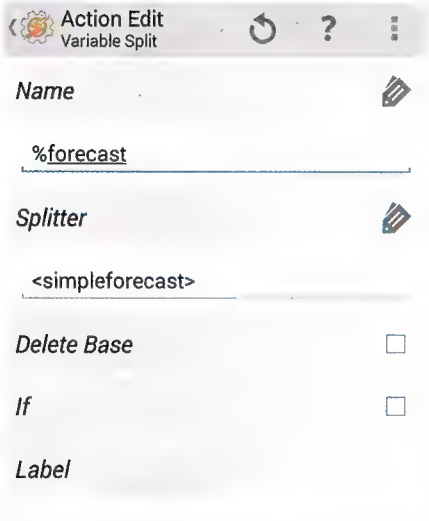
To make sure that the data is stored in a variable with a useful name, I first create a Variable Set Action that copies %HTTPD to the variable %forecast (note the lower-case lettering, which sets it as a local variable).

To make sure that everything is working correctly up to this point, I recommend adding in a Flash action containing %forecast, then running the task and checking that the toast notification matches the content that you're expecting.

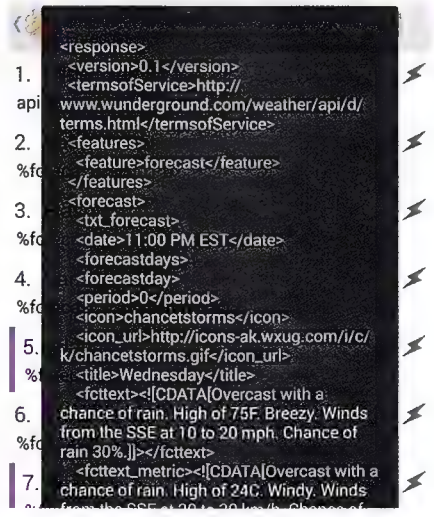
The next part is a series of Variable Split Actions, each one reducing the %forecast variable down until we're left with only the value we wanted.

The XML file that we're working with has the Max temp value contained in a section tagged <simpleforecast>, then under the tag <high>, and <celsius>. So, the first thing I did was to split the %forecast variable by <simpleforecast>.

What the Variable Split action does is look for a specific string of text within a variable, and then splits that original variable into a new one every time it finds that text. For instance, say the



The Variable Split Action is used to isolate the data we need, and place it into a local variable.

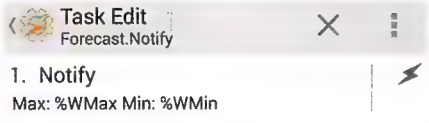


Use Tasker's Flash Action to help in debugging your Variable Splits.

Moving forecasts

Get forecasts to follow you to different locations.

One problem with the alarm clock that I mentioned is that the location of the forecast is static. Advanced users may enjoy the project of replacing part of the URL called in the HTTP Get request with the Tasker variable %LOCN (the battery-friendly 'Location by network'). Info on how to get the API to accept Lat/Lon coordinates is at: **www.wunderground.com/weather/api/d/docs?d=data/index**.



You can then use this variable anywhere you like in Tasker, and can even perform logic on it.

> "You can have Tasker pop online to find today's maximum temperature and warn you if you should grab a jacket."

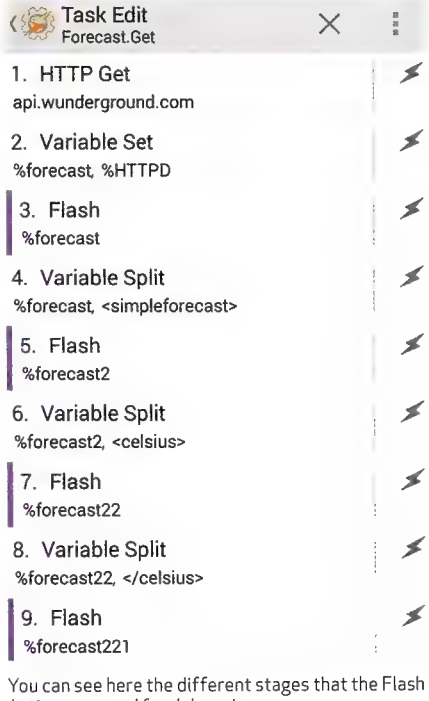
variable %delicious contains 'ice cream,cheese,dumplings'. Using the Variable Split Action with ',' specified will create the variable array of %delicious1 (ice cream), %delicious2 (cheese), %delicious3 (dumplings). If you were to then run the Variable Split on %delicious1 with a space defined as the splitter, you would end up with %delicious11 (ice) and %delicious12 (cream). Keep this in mind when you're splitting second-generation variables if you had more than 10 variables created in the first split, as %delicious11 (as in one point one) will overwrite %delicious11 (as in eleven).

So, let's start splitting up %forecast. First, split it by <simpleforecast> to isolate just the section we're after. This will create two variables: %forecast1 (everything before <simpleforecast>); and %forecast2 (everything after <simpleforecast>). Again, I'd recommend using the Flash action after each of these splits to check that your variable of interest contains the value that you're expecting (using the XML file open in your desktop browser as reference).

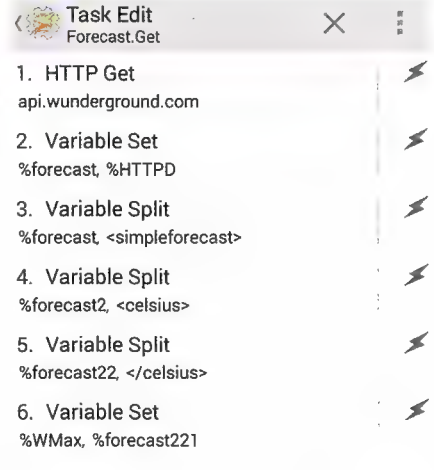
Continue with another Variable Split to isolate the first Celsius section (it contains the <high> value), splitting %forecast2 by <celsius> (creating 3 variables: %forecast21, containing the junk before <celsius>; %forecast22, containing today's max temp + some junk after it; and %forecast 23, containing more junk [which you may like to know, begins with today's low temp]).

Finally, split %forecast22 by </celcius> to isolate the Max value. So that I can use this variable in other Actions, I next write %forecast221 to the global variable %WMax, using a Variable Set Action. Compare this value to the value you expected from your XML file. If it differs, you'll need to troubleshoot your Variable Splits and arrays using Flash Actions.

Now that we have a variable for today's max temp, we can display it in another task, or even perform logic on it (e.g. if %WMax < 17 set %Clothes to "Better grab a jacket!" etc.). So, it's now almost trivially easy to place %WMax in a notification (using the Notify Action with Title specified as 'Max: %WMax'). You can then call this Notification task either at a specified daily time (creating a Profile using a Time event), or even after your alarm triggers (a Profile based on the Alarm Clock Event – although, this won't work on all phones, so you may have better luck using Gentle Alarm and its Tasker plugin). ■



You can see here the different stages that the Flash Action was used for debugging.



The finished task with all the debug Flash Actions removed.

APC doesn't believe in waiting when it's easier to just build our own.

Create a SteamOS box

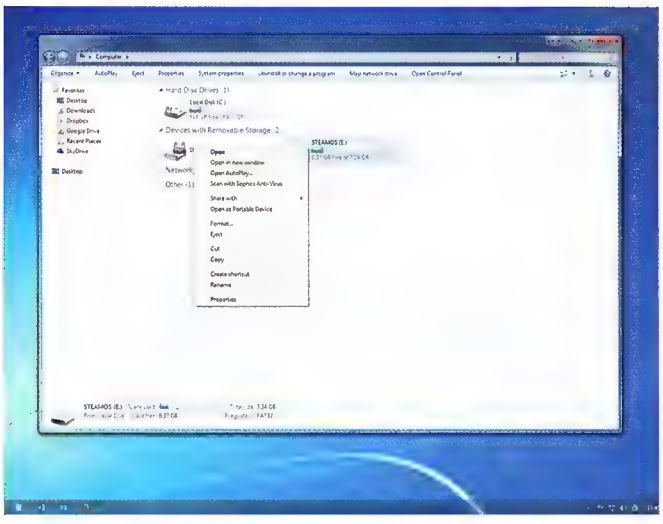
There's no need to wait for companies to start selling pre-built Steam Machines when you can put SteamOS on your PC today — follow along as Tom McNamara loads it onto last month's PC Builder rig.

The mission If you're a PC gamer, you probably noticed that Valve Software and Microsoft aren't BFFs these days. Valve uses its own Steam software client to deliver thousands of games to PC gamers around the world, and it is probably concerned that at some point Microsoft is going to want a piece of the action, just like how Apple takes a percentage for each sale via iTunes. Valve is apparently so concerned with the direction it thinks Microsoft is headed that it's gone to the trouble of building an entirely new operating system just for its Steam client, and dubbed it SteamOS. It's a free Linux distribution, and it's designed to run on pre-built Steam Machines, which are console-size and due this year. However, it will run on any current PC, so we figured we'd take it for a spin this month to see how it feels. We did it because, aside from the joy of tinkering, SteamOS runs a surprisingly large number of games, and one day it will be able to stream games to your TV from a computer. To satisfy our curiosity, we decided to install the SteamOS on a DIY machine we had in the Lab.

We were not among the 300 lucky SOBs who scored a Steam Machine direct from Valve for beta testing, so we installed SteamOS on a machine we created in last month's PC Builder. SteamOS only runs on Nvidia video cards at press time, though, so we swapped the system's AMD Radeon R9 290X for a GeForce GTX 780. Since this PC Builder is focused on software rather than hardware, we'll skip the usual components chart and just give you a quick rundown right here. Our box has an Intel Core-i7-4770K, 16GB of DDR3 RAM, a gold-rated 550W Seasonic power supply with modular cables, and a 256GB SSD and 1TB WD Black hard drive. SteamOS requires a motherboard that uses UEFI and a 64-bit CPU. Valve recommends at least 4GB of RAM and 500GB of storage space. Some familiarity with Linux is also helpful, but it's not required. To install SteamOS, we'll also need a 4GB USB flash drive. And this is very important: Just like with Windows, whatever drive you install SteamOS to will be formatted during the install, so if you are looking to dual-boot you will want to keep that OS on a different partition or drive altogether. In fact, we recommend disconnecting the device with Windows on it while installing SteamOS, just to be safe. Also, the build of SteamOS that we used does not have a complete audio package. The only way to get sound is over an HDMI cable, either to a receiver or a flat-panel display with integrated speakers.

Roll your own

We show you how it's done.

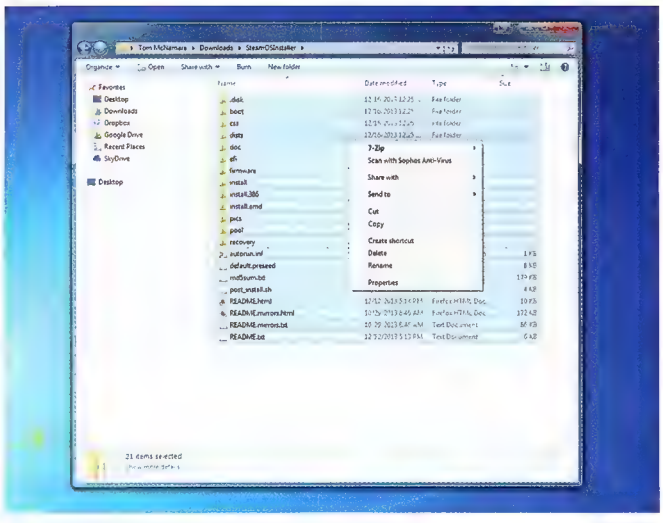


1 DOWNLOADING THE PACKAGE

Download the 950MB installer package from Valve's servers at **repo.steampowered.com/download**. There are torrents floating around, but none are officially approved. The SteamOS installer download is a ZIP file instead of the ISO that you'd usually use to install an operating system. You can create an ISO from this package and burn it to disc, but a lot of people (including ourselves) experience difficulty doing this, so we instead extracted the files to a USB key. Be sure to back up any important data on your flash drive, because you'll need to format it as FAT32 for the installation (most USB keys default to this file type during formatting). Just open Windows Explorer, right-click your flash drive's icon, select Format, make sure the file system is set to FAT32, and click the button labeled Start. When the installer is done downloading, extract it to the USB stick.

3 BEGIN THE INSTALL

The actual installation of SteamOS is pretty easy, since it's almost entirely automated. Just shut down your system, detach your Windows drive, plug in the USB key with SteamOS on it, start your PC again, and press your motherboard's preferred key for accessing the boot menu. This should list your flash drive with a UEFI tag at the front. Choose that, select 'Automated Install' from the next menu, and go grab a bite to eat because it will take about 30 minutes to install on a mechanical hard drive.



2 EXTRACTION BEGINS

Windows has built-in ZIP file extraction these days, so you can just double-click on the freshly downloaded file to view its contents, hit Ctrl-A to select everything, Ctrl-C to copy it all, then double-click your flash drive in Windows Explorer, and press Ctrl-V to begin the transfer. It's a large file, so that could take 15 minutes to half an hour, depending on the speed of your CPU and whether you're using USB 3.0 or 2.0. While the files are being extracted and copied over, we recommend digging up your motherboard manual or looking online to find out which button to press on boot to access a Boot Selection menu so that you can boot from the USB key. It's usually F12, but varies by mobo. Also, we recommend installing Steam to a mechanical hard drive as SSD optimization in Linux can get complicated if you're not familiar with the OS. If you want to take a stab at it though, here's the official guide: **https://wiki.debian.org/SSDOptimization**.

On the desktop

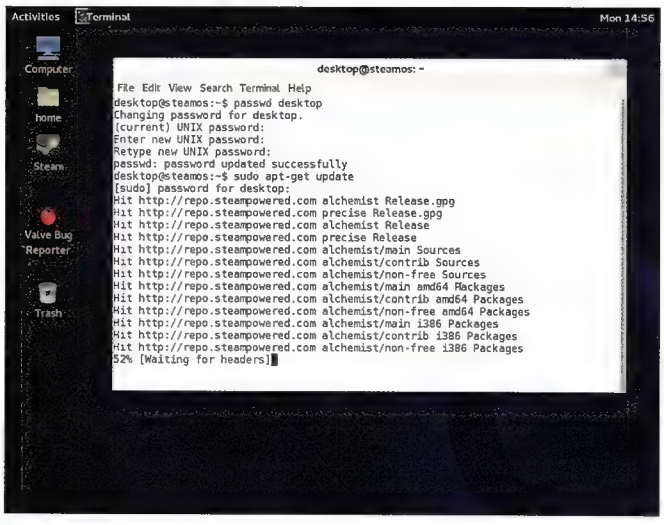
Alt+Tab switches between applications. Window previews of the applications with multiple cycle through. The previews show up after a short delay, but you can get them immediately key. You can move between the preview windows with the Right and Left arrow keys or wit Previews of applications with a single window are only available when the Down arrow is e switch to any window by moving to it with the mouse and clicking.

Alt+Shift+Tab cycles through applications in reverse direction.

Alt+[*key above Tab*] (eg, **Alt+`** on a US keyboard) switches between windows within an ap from within the Alt+Tab switcher, or from outside it (to open the switcher with the window application already selected).

4 GET TO KNOW LINUX

While the OS is installing we'd recommend taking some time to check out some basic Linux commands and concepts, if you're not already familiar with them. SteamOS is a variant of Debian (version 7, code-name Wheezy), so Googling the latter will give you info on the former. SteamOS also uses the Gnome Shell for its desktop environment, and that comes with a set of keyboard shortcuts that are handy to have at your fingertips. The makers of Gnome keep a cheat sheet here: **tinyurl.com/nzxv2gq**. Most of them will be familiar to Windows veterans.

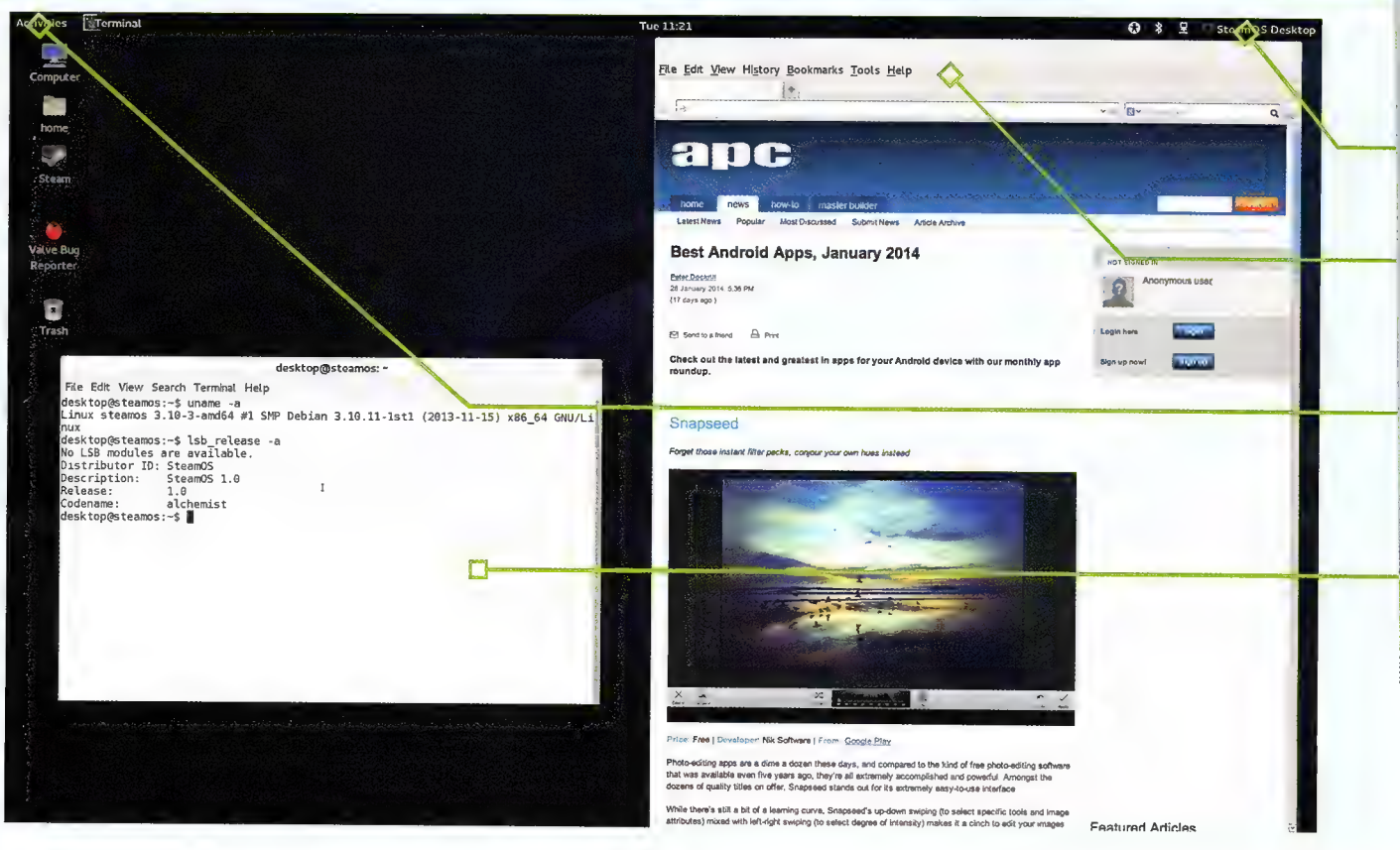


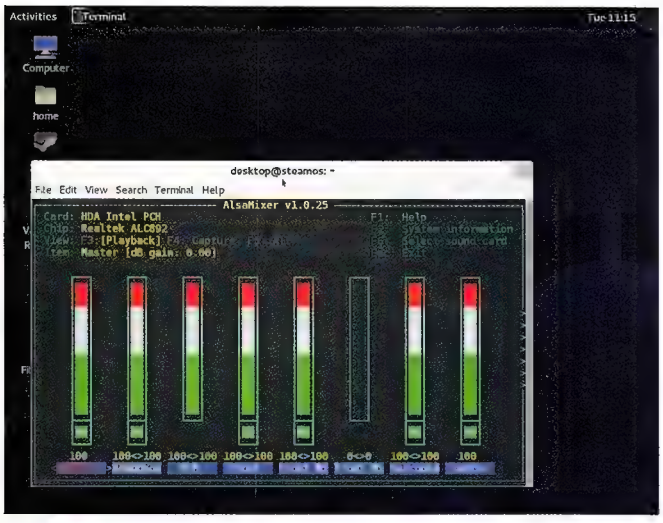
5 YOU HAVE ARRIVED

Once SteamOS has installed, it will prompt you to reboot your PC. At the login screen, the user name is steam, and the password is steam. You can change this later. Note the drop-down menu right below the password field. Selecting SteamOS will launch you directly into Steam's Big Picture mode, which uses an interface designed for living room TVs set about 10 feet away from the user. Default Xsession will give you the Gnome Shell desktop instead. We're not sure if this menu will even be accessible once SteamOS is out of its beta phase, but you should take a look at Gnome, now that it's actually on your computer. The first order of business is to finish the install, via the command-line terminal. Select Activities in the upper left-hand corner of the screen, choose Applications, and click Terminal. Type `su desktop`, use desktop as your password, type `./post_logon.sh`, and hit the Y key to confirm a series of automated steps. You can also open the terminal by pressing Alt-F2, typing `gnome-terminal` and hitting Enter. Alt-F2 is basically like Windows's Run dialog.

6 OPENING THE VALVE

Once the post-install script has completed, reboot the system, and you will be launched directly into Steam's Big Picture mode. To get back to the desktop, click the Exit button and select 'Return to Desktop'. The screen will go dark for a few seconds, and you'll be back in the Gnome Shell. There will be an icon on the desktop that you can click to return to Big Picture mode. At this stage, you may need to re-create your account password to correctly establish admin privileges. In a terminal window, type `passwd desktop`, and type in whatever new password you desire. That will allow you to use sudo commands, which temporarily give you administrator privileges for things like installing software or accessing system-wide settings.


Activities
Terminal
Tue 11:21
Computer
home
Steam
Valve Bug Reporter
Trash
desktop@steamos: ~
File Edit View Search Terminal Help
desktop@steamos:~$ uname -a
Linux steamos 3.10-3-amd64 #1 SMP Debian 3.10.11-1st1 (2013-11-15) x86_64 GNU/Li
nux
desktop@steamos:~$ lsb_release -a
No LSB modules are available.
Distributor ID: SteamOS
Description: SteamOS 1.0
Release: 1.0
Codename: alchemist
desktop@steamos:~$
File Edit View History Bookmarks Tools Help
apc
home
news
how-to
master builder
Latest News
Popular
Most Discussed
Submit News
Article Archive
Best Android Apps, January 2014
Peter Dockrill
28 January 2014, 5:36 PM
(17 days ago)
Send to a friend
Print
Check out the latest and greatest in apps for your Android device with our monthly app roundup.
Anonymous user
Login here
Sign up now!
Snapseed
Forget those instant filter packs, conjour your own hues instead
Price: Free | Developer: Nik Software | From: Google Play
Photo-editing apps are a dime a dozen these days, and compared to the kind of free photo-editing software that was available even five years ago, they're all extremely accomplished and powerful. Amongst the dozens of quality titles on offer, Snapseed stands out for its extremely easy-to-use interface
While there's still a bit of a learning curve, Snapseed's up-down swiping (to select specific tools and image attributes) mixed with left-right swiping (to select degree of intensity) makes it a cinch to edit your images
Featured Articles



Metro: Last Light is just one of the many titles already on SteamOS.

7 HISSING NOISES

You may have issues getting audio to work. At press time, there was a bug that muted several outputs, and the built-in audio panel did not display those outputs. As a work-around, we had to manually install a third-party panel that shows everything. ALSA Mixer is one such program, but we want the one specifically built for Debian. To get that, go to desktop mode, open the Applications menu, select Iceweasel, and go to: **packages.debian.org/wheezy/alsa-utils**. Scroll down to the bottom, click AMD64, and choose your download location. Once that's finished, open the terminal and type `cd Downloads`. Then type `sudo dpkg -i alsa-utils_1.0.25-4_amd64.deb`. Now type `alsamixer` in the terminal to bring up the new audio panel. Use the F6 key to cycle through your available audio outputs. Arrow keys cycle through each audio channel, and M toggles the mute. If that doesn't work, you should be able to get audio over HDMI, either through TV speakers or a home theater receiver.

GETTING ON THE TRAIN

Once we had SteamOS up and running, the first order of business was seeing what applications were available in the package and from the repositories, or 'repos'. Unfortunately, it's pretty bare-bones. There's no word processor, image editor, email client, or media player, for example. With Debian, this is usually not a big deal, since it has literally thousands of packages in its repos that are just a few clicks away from installation. But SteamOS doesn't point to Debian's servers, and there's no way to force it to. And they're two different distributions anyway, so you could get hit with incompatibilities and errors even if you could. Therefore, SteamOS, or at least this version of it, does not look like it's meant to replace Windows. It's a stripped-down gaming platform. You can always install packages on your own, or build from source, but that's not nearly as much fun.

With nearly 100 of our 289 Steam games compatible with Linux, however, including nearly all of Valve's titles (though *Counter-Strike: Global Offensive* is a prominent exception), it's a pretty good gaming platform. *Metro: Last Light* is also getting bundled with retail Steam Machines, and a quick scan of our personal library also included popular titles like *Starbound*, *Bastion*, *Mark of the Ninja*, *Fez*, *Football Manager 2014*, and *Monaco*. *DOTA 2*, one of the most popular games in the world, will also be available on SteamOS. Unfortunately for AMD users, SteamOS uses Nvidia's proprietary drivers, so you can't run an AMD GPU at this time.

> "Unfortunately for AMD users, SteamOS uses Nvidia's proprietary drivers, so you can't run an AMD GPU at this time."

We also dual-booted with Windows, which was simple since our test bench had Windows installed on the SSD and SteamOS on the hard drive. We just selected our boot device during startup and were back in Windows-ville. You can also go into the board's BIOS and tell it to boot to a specific drive every time, instead of manually selecting from the boot menu. It's not as clean as getting the Linux boot loader to just see Windows and add it to its own boot menu, but it's close enough for our needs.

Overall, we're not sure at this time if running SteamOS is worth the effort, since you can get Steam for Ubuntu and other Linux distros, where you'll get access to repos and the ability to dual-boot. It's fun to play with though, so if you have a spare drive and some time you should check it out. If you're on Windows though, don't worry — you're not missing anything... yet.

SteamOS

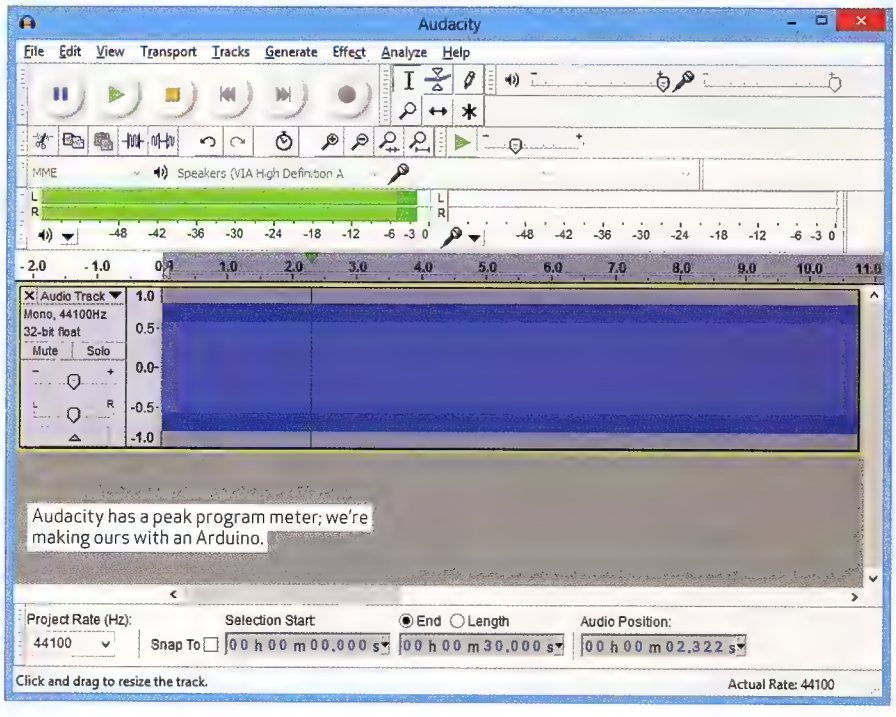
Know your way around.

- To shut down, you need to click the upper right-hand menu and press the Alt key.
- The Iceweasel Internet browser bundled in SteamOS is too outdated for day-to-day use; we recommend using the Steam client's own browser.
- The Activities menu in the upper left is a hot corner (opens when you hover your mouse over it) that shows you both running and installed apps.
- The available commands for the Linux terminal are so extensive that many power users don't even have a desktop environment.

Project #15 – Stereo Peak Program Meter

This month, we put the Arduino's analog-to-digital converter to use measuring audio signal levels. Darren Yates explains.

Last month, we introduced the Arduino's analog-to-digital converter (ADC) in detail, looking at successive-approximation A-D conversion and how it's the best compromise between speed and cost. This month, we start putting some of that theory into practice by building a stereo peak-program meter.


Audacity
File Edit View Transport Tracks Generate Effect Analyze Help
Audacity has a peak program meter; we're making ours with an Arduino.
Project Rate (Hz):
Selection Start:
End
Length
Audio Position:
Click and drag to resize the track.
Actual Rate: 44100

MODERN-DAY VU METER

VU or 'volume unit' meters have been around for years as a visual aid used by professional audio engineers to gauge the voltage levels of an audio signal. Today with the prevalence of digital audio recording, a different type of meter is more commonly used that presents a linear display of a logarithmic voltage scale and it's called a 'peak program meter' or PPM. When you're recording audio with a digital recording device, the rule is never allow the signal level to exceed the maximum sample level (known as 0dBFS); otherwise, you end up with clipping distortion, which sounds like your music is playing through a gravel pit. A PPM gives you a clear indication of how 'close to the wind' you're sailing.

HOW IT WORKS

Digitising audio turns an analog voltage into a digital representation or 'sample' – the number of bits in the sample determines its precision (and helps with accuracy). It's why 16-bit audio almost always sounds better than 8-bit audio – more bits, greater precision, better accuracy. In the real world, the louder the sound, the larger the voltage – and when sampling that voltage, the closer to the maximum digital sample it'll be. This maximum sample is known as 'full scale'. Audio signals are typically measured using a logarithmic scale called decibels (dB) and our PPM measures the in-coming audio signal as a logarithmic ratio with respect to this 'full scale' limit. For an incoming signal that is at the maximum sample level, that ratio is said to be 0dB relative to Full Scale (FS) – and that's how we get the '0dBFS' tag.

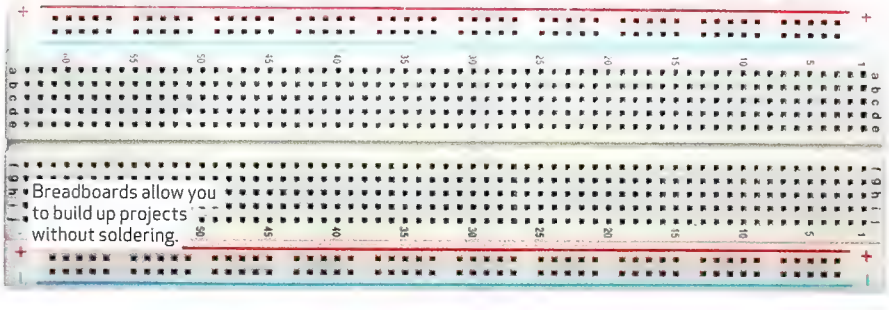
To work out this relative ratio of an incoming audio sample, you use the basic equation:

```
dB = 20 x log10(input/FS)
```

where 'input' is the input signal as a digital sample level, 'FS' is the maximum sample level and 'log10' is the log function to base 10.

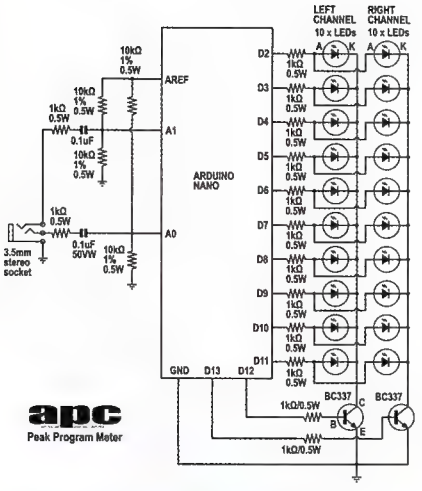
Let's say the input signal level was half-FS – that would be dB = 20 x log (0.5 / 1) = 20 log (0.5) = -6.02dB. If the input was only at 10% of FS, it'd be dB = 20 log (0.1) = -20dB. With the input at 1/100th of FS, that works out to be dB = 20 log (0.01) = -40dB.

Hopefully you can see a few things from this – every time you drop half the signal level, you drop 6dB; every order-of-magnitude drop (or divide-by-10), you drop 20dB. Since the signal level is always less than full scale, the logarithmic scale always produces a negative number – the larger the absolute number, the smaller the input signal.

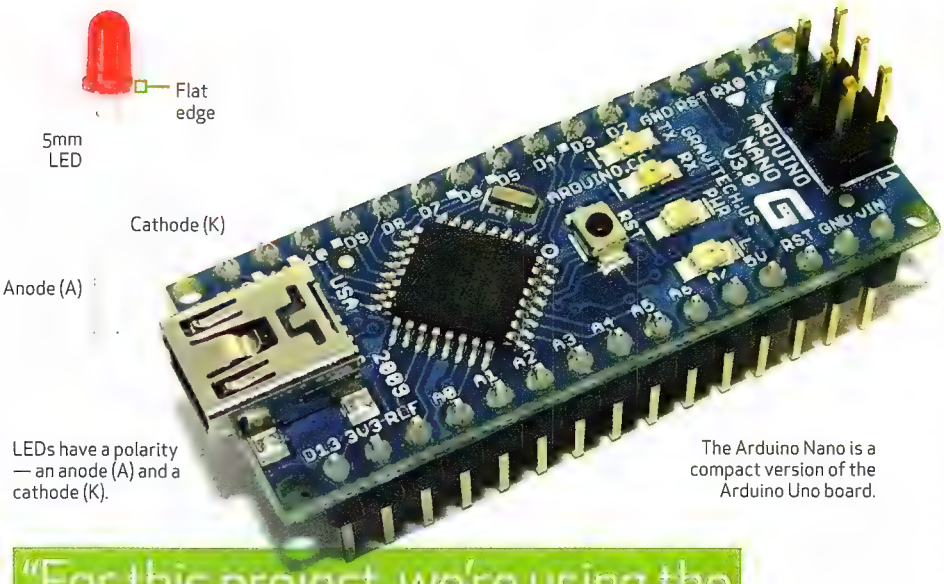

Breadboards allow you to build up projects without soldering.

Sketch download

You can download the sketch for this project from our Arduino page over at **apcmag.com/arduino.htm**. It's designed for Arduino IDE v1.0.5.



The circuit diagram of our Arduino PPM project.



LEDs have a polarity — an anode (A) and a cathode (K).

The Arduino Nano is a compact version of the Arduino Uno board.

DYNAMIC RANGE

When you sample an audio signal, the number of bits in the ADC determines what's called the 'dynamic range', the ratio between maximum and minimum samples (or loudest and softest sounds) it can capture. The 16-bit ADC in your PC's sound card can capture 65,535 possible signal steps. Using a slight twist to our equation, we get:

```
dB = 20 x log10 (ADC steps)
= 20 log10 (65535) = 96.32dB
```

You may have heard that audio CDs (also 16-bit sampled) have a dynamic range of 96dB — this is how they get it. However, the ADC in the Arduino's ATMEGA328P microcontroller is only 10-bit, which gives a maximum dynamic range of 20 x log10 (1024) = 60.2dB. So from that, we know we can only cover a very tiny portion of that 16-bit range — the top 1,024 rungs in a 65,535-step ladder if you like — but represented as a logarithmic scale, we actually cover more than half of that range (54 of 96dB), which is more than enough for our PPM to do its thing.

> "For this project, we're using the Arduino Nano, a compact, 'breadboard-able' version of the Arduino Uno R3 using the same ATMEGA328P microcontroller."

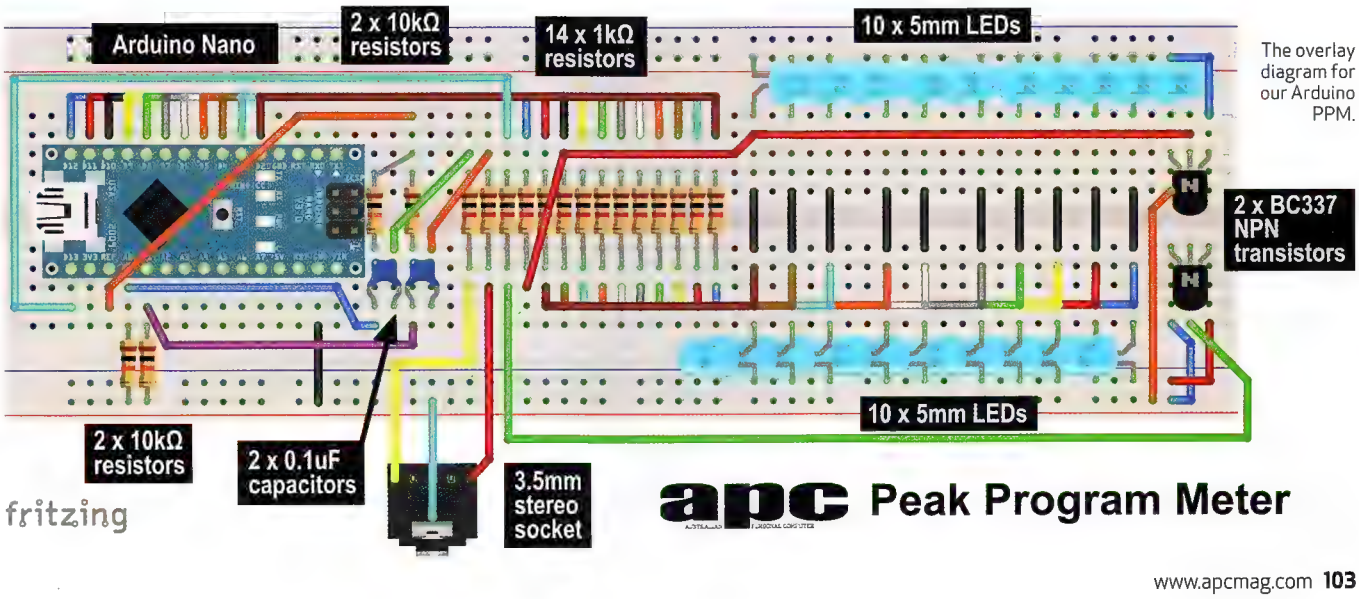
MAKING OUR DISPLAY

As we said at the top, a PPM is a linear display of a logarithmic scale. We've covered the log scale; now let's look at the linear display. What we want to do is produce a stereo (right- and left-channel) bargraph-style display, so the first thing we need to do is look at the digital I/O ports we have to play with.

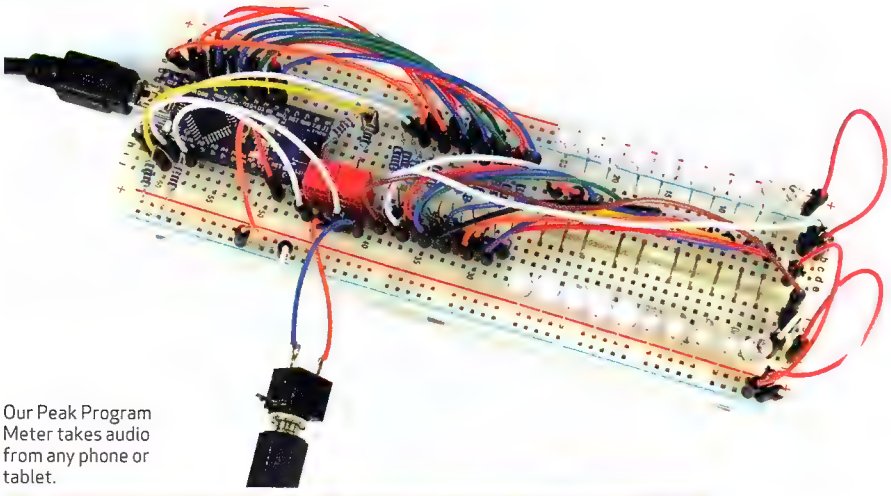
For this project, we're using the Arduino Nano, a compact, 'breadboard-able' version of the Arduino Uno R3 using the same ATMEGA328P microcontroller.

The Nano gives us 14 digital I/O ports, which, if we use one per LED in our display, creates two banks of seven LEDs. That's not bad, but we can do better — we'll use 12 I/O ports to drive 20 LEDs, ten per channel. More on that in a moment.

The PPM's linear scale is designed to make it easy to follow since each LED represents a fixed decibel step, however, most PPMs built from discrete components only manage an approximate logarithmic scale or 'decibel linearity' because it's actually quite hard to do. Our meter gets around that problem but also has perfect decibel linearity, thanks to the 'mathemagic' we do inside the Arduino. And as a little something extra, you can set the decibel-per-LED scale in the Arduino sketch (code).



The overlay diagram for our Arduino PPM.



Our Peak Program Meter takes audio from any phone or tablet.

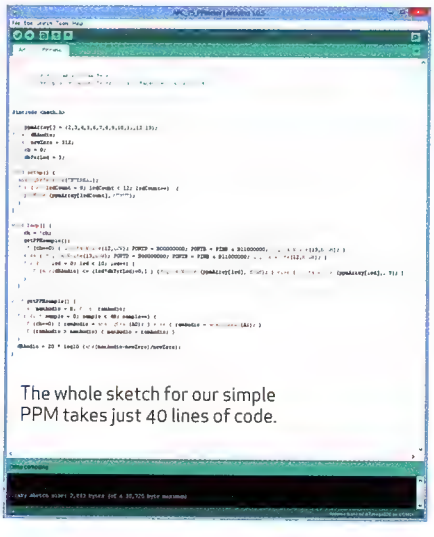
PPMs are a must on good-quality digital audio recorders.

> "During development, we had a problem whereby we were getting brief 'crosstalk' errors with one sample lighting up the other LED bank just briefly as the multiplexing transistor took time to switch off."

DRIVING THE LEDS

So how do we get 12 digital outputs to drive 20 LEDs? We use a technique called 'multiplexing'. It takes advantage of the fact that our eyes are pretty hopeless at noticing fast changes much beyond about 60Hz. We take ten I/O ports connected to ten 1,000ohm resistors, but then use an extra two I/O ports to drive two transistors, each controlling a bank of ten LEDs. If you time everything just right (and timing is everything in this project), you can switch the ten digital outputs between the two banks of LEDs, with each bank showing a different audio channel. Switch between the banks fast enough and it looks like you have two completely separate displays handled by two ADCs, when in reality you only have one ADC and some 'sleight-of-hand' multiplexing.

You can see in the circuit diagram that each LED pair is connected to digital ports D2 through D11 via those 1,000ohm resistors. LEDs are the electrical equivalent of cars with no brakes and these resistors protect both the Nano's digital ports and the LEDs from blowing up. Standard 5mm LEDs typically only handle 20mA of current before they get cranky and the Arduino can deliver up to 40mA per I/O port. The 1,000ohm resistors limit the current to around 2-3mA – more than enough to light each LED (we're not lighting up the Opera House) but stay well below everyone's maximum ratings.



The whole sketch for our simple PPM takes just 40 lines of code.

PROTECTING THE ADC

But the LEDs aren't the only elements needing protection. We know an ADC turns analog voltage into digital samples, but that input voltage range by default is set to 0-5VDC, the Arduino's supply voltage. The problem is that audio is an AC (alternating current) signal and its voltage 'swings' positive and negative. If we feed a raw AC audio signal straight into the ADC input, not only can't we measure the negative-going voltage swings, those swings also have the potential to blow up the ADC's input circuitry.

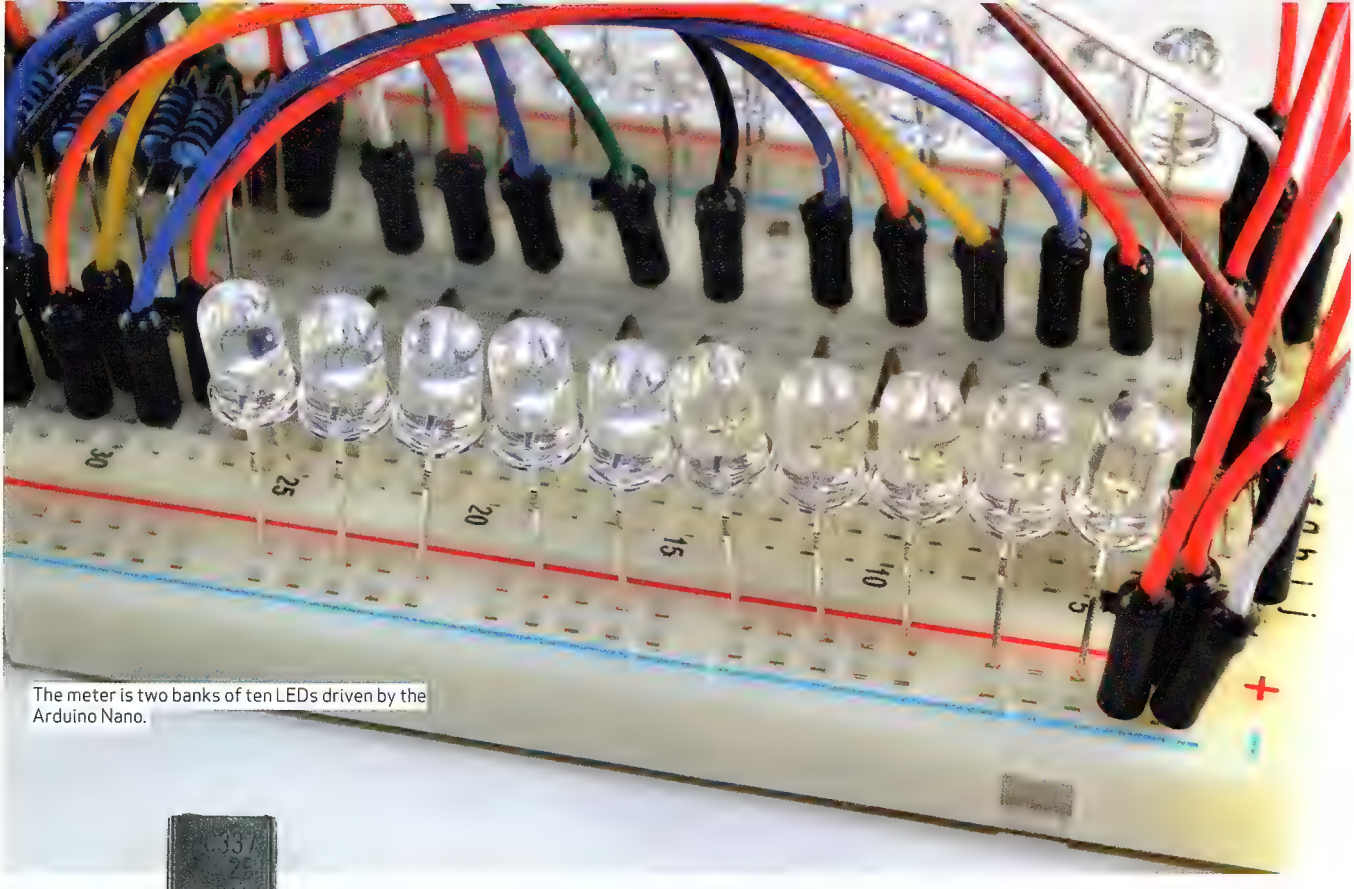
The solution is to lift up or 'bias' each ADC input to a voltage that's (within 1%) exactly half-FS through two 10,000ohm 1%-tolerance resistors connected between the AREF (analog reference) port and ground. The capacitor at each input allows us to piggy-back our audio signal on top, so that the ADC now sees the positive and negative voltage swings about this new half-way point. It requires a little more mathematical judo, but it means all of our circuitry stays happy. The 1,000 ohm resistor at the very front of the input ensures that no damage can be done if the audio voltage peak exceeds the Arduino 5VDC supply voltage (within reason).

BUILDING THE METER

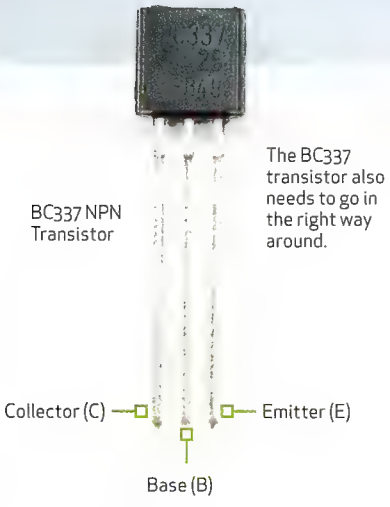
We've engineered our meter on a standard 830-tiepoint breadboard, but the final version would receive a purpose-built circuitboard or general-purpose veroboard. The audio input can come from your phone or tablet via a 3.5mm to 3.5mm stereo cable. We're using 5mm high-brightness white LEDs but you can choose any colour you wish. A Fritzing overlay diagram gives you a closer view of how we engineered the project.

THE SKETCH

The multiplexing adds some complexity but it's the sketch (that's Arduino for 'program code') that pulls the project together. That said, we've deliberately kept the sketch as simple as we can so you can see how each



The meter is two banks of ten LEDs driven by the Arduino Nano.



section works, the whole thing taking just 40 lines of code. There are four mains sections – setup, digital sample acquisition, mathematical conversion to dB scale and driving the LEDs.

The standard logarithmic function is just one mathematical hurdle we have to jump, but it's not part of the basic Arduino codebase, so we include it by adding the math.h header file through the #include <math.h> code line. This file comes with the Arduino IDE, so we're not including in our project download. Math.h provides a number of other useful functions, including sine, cos, tan and their trigonometric inverts.

Remember that an Arduino sketch is designed to run through the setup() procedure once and infinitely around the loop() procedure until power is removed, so the first thing we do in the setup() routine is set the analog voltage reference (AREF). Our ADC has to compare the input voltage to a reference voltage in order to create a meaningful sample. As we mentioned before, the Arduino Nano/Uno R3 just uses the 5VDC supply voltage, but we can gain greater sensitivity by using the ATMEGA328P's internal 1.1VDC voltage reference instead. The analogReference(INTERNAL); codeline sets AREF to this new reference.

To further simplify coding, we add the digital I/O pin numbers (the ten LED outputs plus the two multiplex drivers) to an integer array and use that array here to assign each one as a digital output. After that, we hit the main loop() procedure.

The first thing we do here is acquire our digital sample through the getPPMsample() procedure. A standard PPM has a five-millisecond integration time and we cover that by getting the ADC to take 48 samples, noting the highest peak. With the default ADC sampling rate 9.6kHz, multiply that by 48 samples and you get five milliseconds.

To work out which channel we sample, we create an integer variable called ch and use the command ch=!ch to toggle it between one and zero. If ch equals zero, we read from analog input A0; otherwise we read A1.

Now here's where we correct the ADC sample scale – once we have our peak sample, we need to change the scale so that the half-FS point (sample-level 512) becomes the new zero-point, allowing us to work out the peak sample. Our ADC has 1,024 steps so half-FS has to be 512. The solution is to simply subtract 512 from each sample and we now change the scale from 0/1024 to -512/+512. We take the absolute value of the peak and work out the dB ratio of the sample using the single equation:

```
dBAudio = 20 * log10
(abs(maxAudio-newZero)/
newZero);
```

Changing the scale loses us 6dB of dynamic range because we now have 512 steps instead of 1024, but this has to be done to measure the peak sample of both positive and negative-going voltage swings.

Back in the loop() procedure, we now flip the multiplex switch and using the for() loop, we switch on the appropriate number of LEDs in the bargraph to match the dB scale of our peak sample for that audio channel. Once that's done, the loop() procedure restarts, we take our next set of samples and around we go again.

PORT MANIPULATION

The standard way of writing to digital outputs is through the digitalWrite command, however, there are times where it's not fast enough. During development, we had a problem whereby we were getting brief 'crosstalk' errors with one sample lighting up the other LED bank just briefly as the multiplexing transistor took time to switch off. The solution was to write the digital outputs using the fast PORT command. PORTD covers D0 to D7 and PORTB handles D8-D13, so by writing PORTD and PORTB to zero, the I/O ports drop to zero much faster and the crosstalk display errors are fixed.

ONLY THE START

The Arduino's ADC might well be modest by today's standards, but it's still arguably its most important feature, linking the real analog world to the digital computing environment. And this is just one way you can use the ADC. We're sure you can come up with dozens more! ■

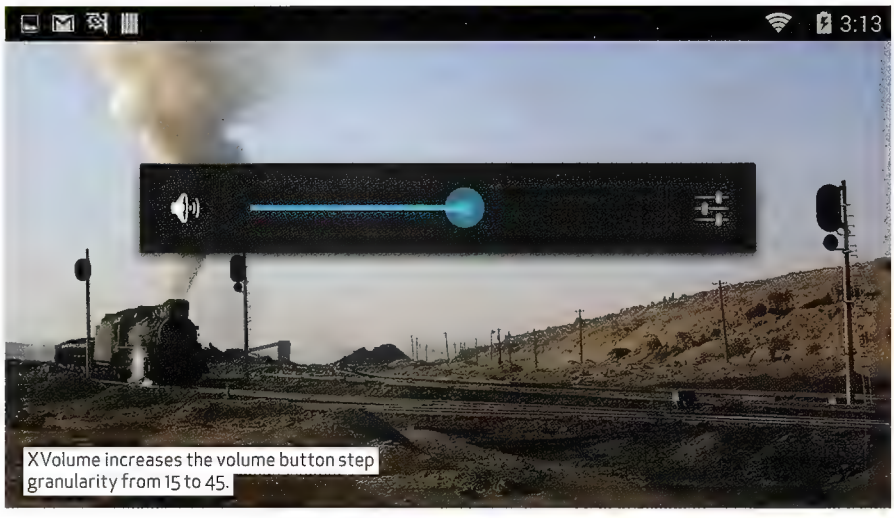
Android Xposed

Customising your phone no longer requires a custom ROM — you just need a framework. Darren Yates explains.

For the average user, phone customisation usually extends no further than installing apps from Google Play. But for serious Android fans, that's not even where it begins. Few serious users can live without their custom ROMs, ROMs that have been modified, root-accessed and rebuilt to within an inch of their lives in order to ditch the bloatware and add in must-have features. But custom ROMs don't work for everyone and often see original device features disappear through a lack of openly-available driver code.

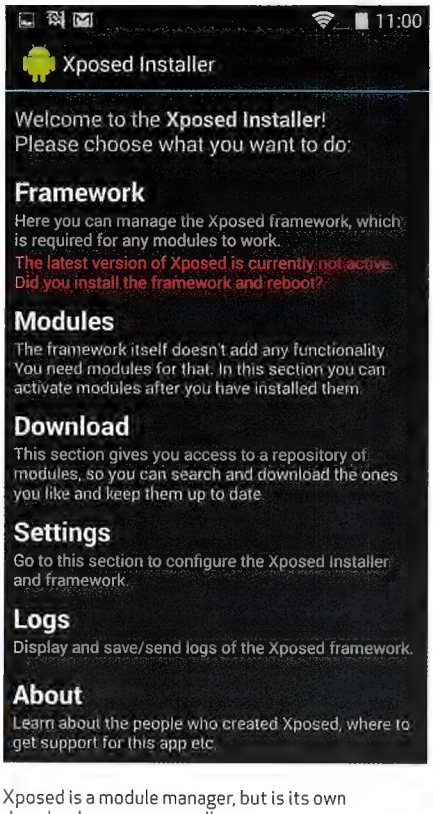
One example is CyanogenMod and Samsung's Galaxy S3. The phone has included Miracast (de-facto wireless-HDMI) support in Samsung's stock ROMs since Jelly Bean (Android 4.1), but CyanogenMod and most AOSP (Android Open Source Project) ROMs often have it missing. A reader of our sister publication, *TechLife*, recently tried CyanogenMod on his Samsung Galaxy S2 phone, only to find that his GPS no longer worked. He decided he wanted to go back to a stock ROM.

Custom ROMs are great at providing new features not found in stock ROMs and losing the bloatware, but for many, the cost of losing phone functionality becomes too high. However, there's an increasingly popular alternative that allows advanced users to have the best of both worlds — stock ROMs but with ultimate control over the Android OS. It's called the Xposed Framework.



XVolume increases the volume button step granularity from 15 to 45.

Grab the Xposed Framework from **dl.xposed.info/latest.apk.**


11:00
Xposed Installer
Welcome to the Xposed Installer!
Please choose what you want to do:
Framework
Here you can manage the Xposed framework, which is required for any modules to work.
The latest version of Xposed is currently not active. Did you install the framework and reboot?
Modules
The framework itself doesn't add any functionality. You need modules for that. In this section you can activate modules after you have installed them.
Download
This section gives you access to a repository of modules, so you can search and download the ones you like and keep them up to date.
Settings
Go to this section to configure the Xposed installer and framework.
Logs
Display and save/send logs of the Xposed framework.
About
Learn about the people who created Xposed, where to get support for this app etc.

Xposed is a module manager, but is its own download manager as well.

A DIFFERENT KIND OF 'CUSTOM'

The traditional way to get your favourite customisations into your Android device is to bake them into a custom ROM, flash it to your device and away you go. The Xposed Framework is different — it allows you to customise virtually any part of the Android OS right down to the system level without the need for a custom ROM. It works with any Android OS from 4.0 up — including stock ROMs, so you get all the functionality of your stock ROM, but the ability to modify it as though it was a custom ROM.

HOW IT WORKS

Xposed hacks into Android's Dalvic runtime engine — inside the engine, there's a process responsible for running all Android apps called Zygote and it's launched from the /init.rc initialisation script as soon as

Warning!

Use it at your own risk.

The Xposed Framework requires root access and modifies your Android device's operating system. We recommend you make a Nandroid backup of your device and know how to restore it before installing the software in case things go wrong. While we have successfully tested the information in this article, it is provided as-is and without warranty. Use it at your own risk.

your Android device kicks over (we looked at this script in our 'Build your own Android ROMs' masterclass series back in the November 2013 issue). Zygote is launched by the /system/bin/app_process executable and the Xposed Framework's trick is to replace this executable with a modified version that loads up an extra file – a Java archive (.jar) called /data/xposed/XposedBridge.jar. As its name suggests, it acts as a bridge into Zygote, allowing you to run extra code as if it was part of Zygote itself.

According to Xposed's creator, Rovo89, the framework lets you hook into Android's 'method' calls (a method is Java's version of a function in C++ or a procedure in Visual Basic). Not only that, but you can redefine anything about the Method object and even replace it with your own – all without the original app that called the method knowing about it.

You use the framework by installing 'modules', which are essentially just Android apps that have extra meta-data up front to indicate that they're Xposed framework modules. The beauty of this is that you can run as many modules as you want, each one providing one or more customisations and because they tap into the Dalvic runtime engine (and importantly, do their thing at runtime), you don't need to worry about installing a new ROM.

SECURITY RISKS?

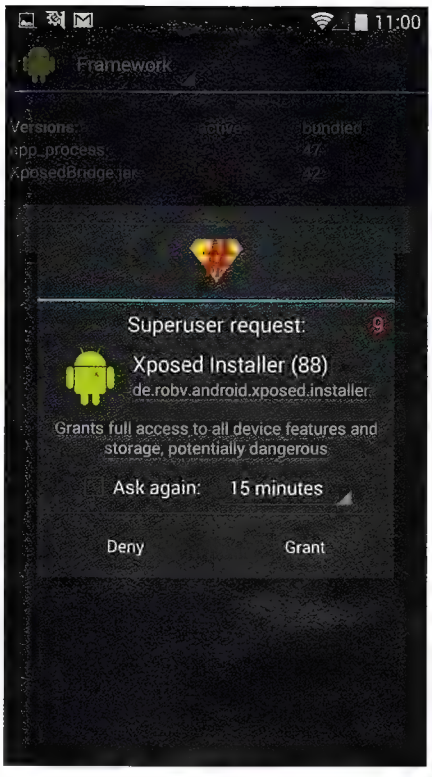
But if Xposed allows code to tap into Zygote, doesn't that pose a security risk? Yep, it does – but then again, so does gaining root-access, installing custom ROMs and almost every other OS-level modification you can do to an Android device. But you can't have this level of access to the runtime engine to run any code you want and expect watertight security at the same time.

What would be worse is if Xposed simply launched modules as soon as they install – if that happened, you could have seemingly harmless apps launching hidden module payloads without you knowing about it, doing untold damage.

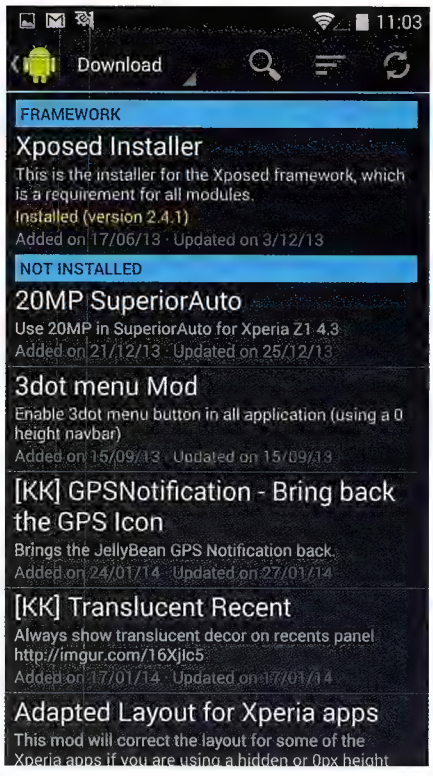
However, Xposed prevents this from occurring by requiring you to enable every module after it's installed. It's similar to SuperSU asking to grant/deny execution of an app requiring shell access.

The module app will install; you can even launch it – but it won't access the Xposed framework until you enable it to do so, ensuring (as much as possible) nothing happens without your knowledge and say-so.

Bottom line, Xposed is a potential security risk, but then, so is much of the fun stuff.



Xposed Framework requires root access for installation — and a reboot.


11:03
Download
FRAMEWORK
Xposed Installer
This is the installer for the Xposed framework, which is a requirement for all modules.
Installed (version 2.4.1)
Added on 17/06/13 · Updated on 3/12/13
NOT INSTALLED
20MP SuperiorAuto
Use 20MP in SuperiorAuto for Xperia Z1 4.3
Added on 21/12/13 · Updated on 25/12/13
3dot menu Mod
Enable 3dot menu button in all application (using a 0 height navbar)
Added on 15/09/13 · Updated on 15/09/13
[KK] GPSNotification - Bring back the GPS Icon
Brings the JellyBean GPS Notification back.
Added on 24/01/14 · Updated on 27/01/14
[KK] Translucent Recent
Always show translucent decor on recents panel
http://imgur.com/16Xjlc5
Added on 17/01/14 · Updated on 17/01/14
Adapted Layout for Xperia apps
This mod will correct the layout for some of the

The Download section provides instant access to a range of Xposed modules.

> "But if Xposed allows code to tap into Zygote, doesn't that pose a security risk? Yep, it does – but then again, so does gaining root-access, installing custom ROMs and almost every other OS-level modification you can do to an Android device."

WHAT YOU NEED

You only need three things to start running customisation modules – a device with at least Android 4.0, root-access and the Xposed Framework. For obvious reasons, you won't find Xposed on Google Play, but you can download the latest version as a standard APK installer file from **dl.xposed.info/latest.apk**. Installation and setup are straightforward – install the APK, launch the app, tap 'Framework', then 'Install/Update'. Once done, you reboot your device and that's it. From there, you can begin installing modules and customising your stock ROM.

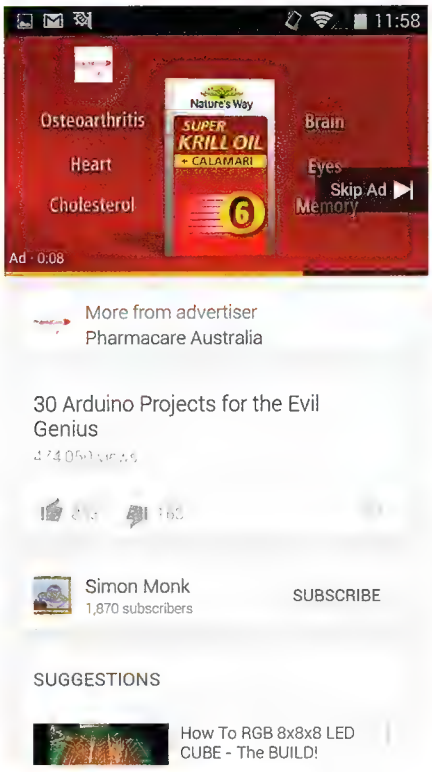
WHERE TO GET MODULES

Because modules are modified Android apps with added meta-data, you won't likely find any in Google Play (Google is a bit funny about apps taking advantage of Android hacks – go figure) but you will find them over at **repo.xposed.info**. You'll also find them in the Xposed Installer app once you've installed the framework. Launch the app and select Download. This will give you a list of 'installed' and 'not installed' modules – in effect, it's your Google Play for modules, initially listed in alphabetical order.

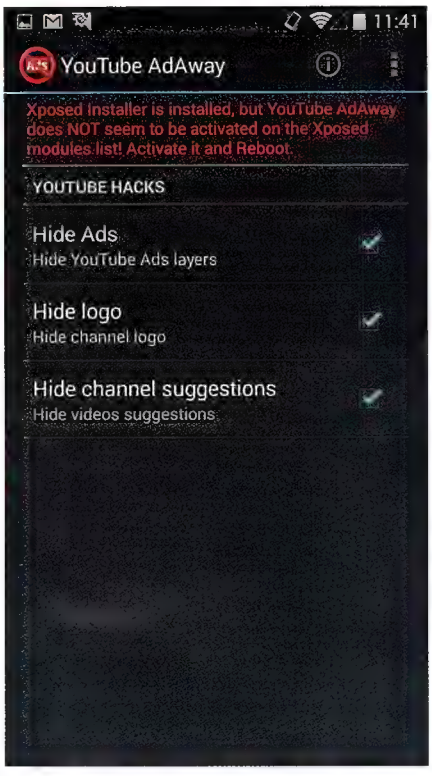
Another place to find the very latest modules is the xda-developer's forum at **forum.xda-developers.com** and just search for 'Xposed'.

INSTALLING MODULES

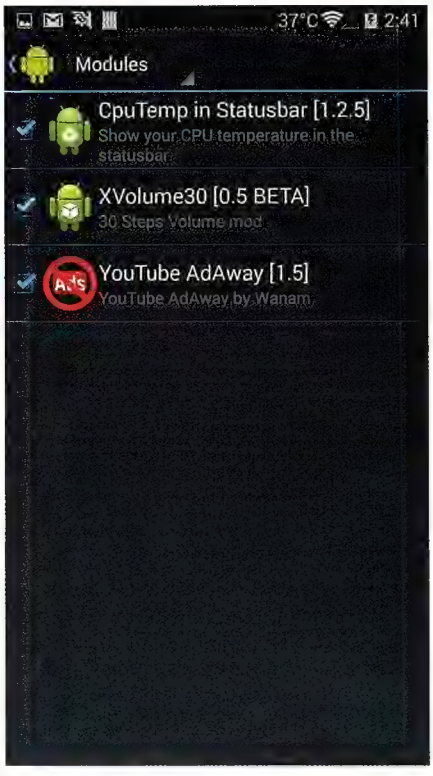
Installing modules is straightforward as well – select a module you want to install from the Xposed Installer app's Download page, read the blurb, scroll down and select the Download button. Download the module APK file, install it and go back to the Xposed Installer app. Select Modules and you should now see the module in the list. Tap the checkbox next to the module to enable it, reboot and the module should be



Android's YouTube app displays pre-play ads — kind-of annoying, right?


11:41
YouTube AdAway
Xposed Installer is installed, but YouTube AdAway does NOT seem to be activated on the Xposed modules list! Activate it and Reboot.
YOUTUBE HACKS
Hide Ads
Hide YouTube Ads layers
Hide logo
Hide channel logo
Hide channel suggestions
Hide videos suggestions

Once you install a module, you can launch its app but you must enabled it in Xposed Installer first.



Enabling a module just requires ticking a checkbox and rebooting your device.

ready to go. Each module's individual features are controlled by the module app while the Xposed Installer app is your module manager. You use Xposed Installer to enable/disable any module at any time by dialling them up in the Modules page, unchecking the relevant checkbox and rebooting your device. Sure, the constant rebooting might seem a chore, but try disabling a custom feature baked inside a custom ROM and see how you go.

WHICH MODULES TO USE

Because it taps into the Android runtime engine, there really isn't anything off limits to customisation. However, while there are plenty of modules to choose from, not all of them work on every device. Since Xposed gives you full access to virtually everything in the OS, it also includes phone-specific functions, resulting in a number of phone-specific modules. Most modules will indicate if they're for a particular phone or can be used on any device. Just don't be surprised if modules not meant for your device don't work.

WHAT CAN YOU DO WITH XPOSED?

You know how Xposed works, but what to do you do with it? There are at least 200 different customisations available so far, some phone-specific as we've mentioned, but others that work on any device.

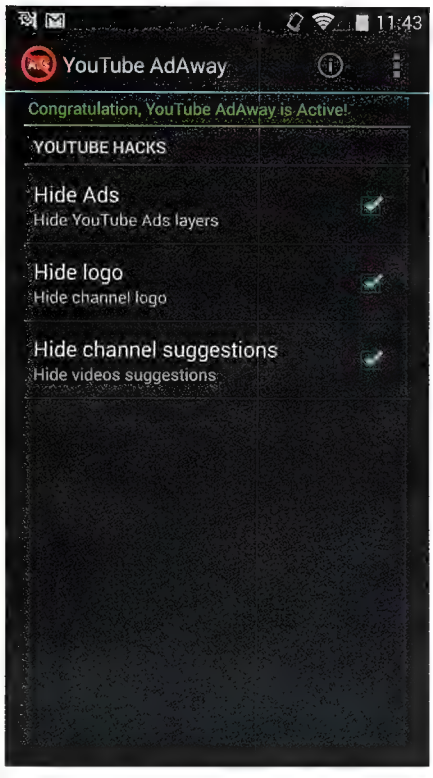
One we've taken a shine to is YouTube AdAway — it's pretty simple: it allows you to hide YouTube ad layers, channel logos and channel suggestions. We tested it on the latest OmniROM 4.4.2 nightly with YouTube update 5.3.32 and it worked a treat — without YouTube AdAway, we saw the usual pre-start ad appear before a video clip; enable AdAway and the same clip played straight away without ads.

> "There's a certain level of kudos that comes from being able to develop your own customised ROM, no question – but the Xposed framework gives developers a potentially larger audience for their wares simply because users don't have to change the device ROM."

This isn't a modified YouTube app; instead, it modifies your ROM's existing YouTube app at runtime to remove the unwanted intrusions. And that's the clever thing about Xposed — it enables modified app behaviour without having to lock into a particular app version or, in most cases, ROM version. What's more, YouTube AdAway is one of those modules said to work with any Android device running at least Android 4.0 and the Xposed Framework.

Another module that shows just how far you can burrow down into the OS and take control is XVolume. It's a simple module with one task — to expand the granularity or number of steps for the volume buttons in both call and media mode. You can choose 15, 30 or 45 steps for each and save the settings. It may not sound all that interesting, but if you're struggling to get your headphone volume just the way you want through too few volume steps, this is the ideal fix. We tested it on our Galaxy S3 phone, cranked it to 45 steps, fire up YouTube and sure enough, we had super-smooth volume adjustment. That said, the phone volume steps didn't change, showing that more-generic customisations may not work perfectly on every device — but it sure beats having to find a custom ROM with everything exactly as you want it.

There are notification modules as well — one geeky one worth a look is 'CPUtemp on StatusBar'. Yep, it could



Come back into the module app and it should indicate it's enabled.

use a snappier name, but as it suggests, this module displays the device's CPU temperature on the statusbar. Now if you're thinking there's an app for that, you're right, there is – but it needs a custom kernel to work. Again, that's the benefit of the Xposed framework – you don't need custom kernels because you're effectively customising your own stock kernel. It's also well worth keeping an eye on the **xda-developers.com** web site for really fresh modules.

One that's just a few weeks old is Intelli3G. This one is clever – it's a 3G network connection manager. It automatically switches your device's network mode from 3G/LTE to 2G whenever you're in range of a Wi-Fi connection, but is smart enough to ensure you don't lose data if the 3G connection is being used. The benefit? Extra battery life – the developer estimates he lost 3-4% battery life per hour on his Nexus 4 phone simply having 3G network mode idling. Switching back to 2G dropped this down to less than 1%. You can check out the app page on the xda-developer's forum at **tinyurl.com/intelli3g**.

MAKING YOUR OWN MODULES

The whole Xposed framework is open-source and the source code is freely available (**tinyurl.com/cd46qco**). Not only that, but you can also create your own modules. Xposed developer Rovo89 has a fairly comprehensive development tutorial over at **github.com/rovo89/XposedBridge/wiki/Development-tutorial** and it's well worth a read, even if you just want to further understand how Xposed works.

Since modules are just modified Android apps, you create modules the same way – using the Eclipse IDE and the Android SDK. In short, the key difference with a module is a meta-data flag the Xposed Installer looks for. You just add this codeline to the module app's AndroidManifest.xml file:

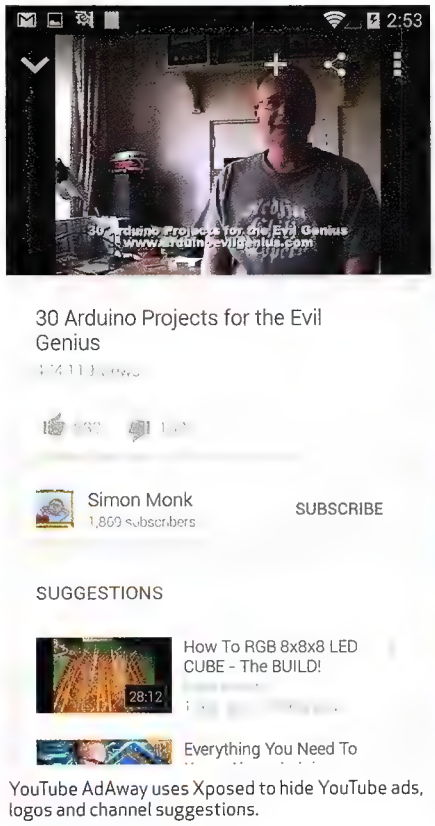
```
<meta-data
android:value="true"
android:name="xposedmodule"/>
```

The flag is 'xposedmodule' and setting its value to 'true' indicates the app is an Xposed module.

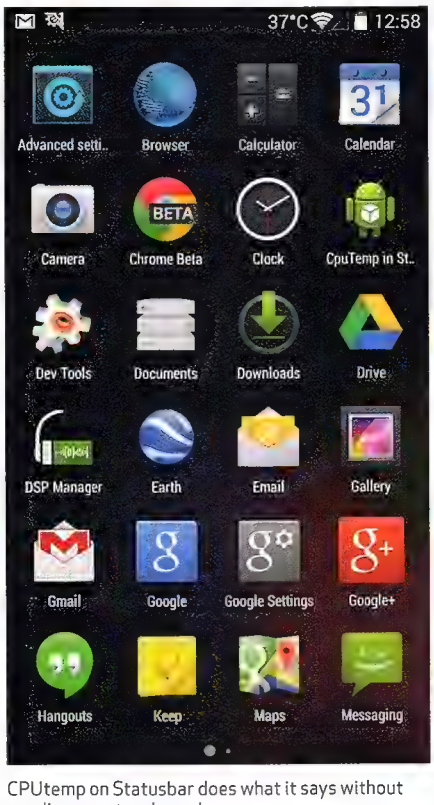
XPOSED'S FUTURE

With Google in the process of switching its runtime engine from Dalvic to ART, you can be sure there are developers galore right now looking at the changes – particularly those that hack into the OS like Xposed. For now, Xposed doesn't run on ART. You'll find that installing the framework on KitKat (Android 4.4+) resets the runtime engine option back to Dalvic. Without this forced change, your device would be stuck in a boot-loop, otherwise. However, it's unlikely Dalvic will disappear any time soon, so don't let that hold you back from trying it out.

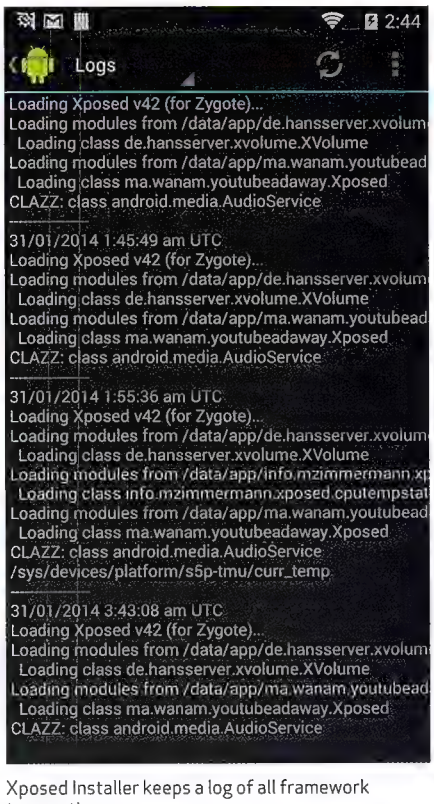
There's a certain level of kudos that comes from being able to develop your own customised ROM, no question – but the Xposed framework gives developers a potentially larger audience for their wares simply because users don't have to change the device ROM. Yes, Xposed requires root-access and is arguably a security risk, but the reward of ultimate customisation of stock ROMs may well be worth it.



YouTube AdAway uses Xposed to hide YouTube ads, logos and channel suggestions.



CPUtemp on Statusbar does what it says without needing a custom kernel.



Xposed Installer keeps a log of all framework transactions.

The undead are better-animated and behaved, but always manageable.

There are so few zombies that you're almost pleased to see one.

DayZ is as brutal and stark as the crumbling tower blocks that dominate its skylines.

$30 | PC | DAYZGAME.COM

DayZ Alpha

A year and a half into development, the DayZ alpha addresses some, but not all, of its issues.

I am exiting an abandoned factory, probably somewhere around Solnichniy, when I hear something completely unexpected in *DayZ*: music.

I think I know the song, even though the melody is too distant to really identify. *DayZ* borrows a great feature from *Arma 2*, the military sim it's built on: the volume of sounds, including player voice communication, drops off over distance. So, remembering absolutely nothing from the *Odyssey*, I jog closer to try to name that tune.

As I come to a wall, I can see a guy sitting cross-legged on a bridge overlooking a pond. He seems to be the source of the music. It's 'I Don't Want to Set the World on Fire' by The Ink Spots, also heard in *Fallout 3*. Seeing that he's unarmed, I tap F1 to wave my arm. He says hello, and we calmly watch the water, basking in a moment of mutual trust. Then, 39 seconds later, some other guy beats me about the skull with a shovel and knocks me unconscious.

DayZ is an open-world sandbox where you'll have memorable, story-generating interactions with strangers, but inevitably be robbed or killed by psychopathic murderers, kidnappers or bandits. At this alpha stage of release, after its transition from mod to standalone game, it remains one of the most brutal and interesting games on PC. It also retains some of the same aggravating issues that were present in the mod while introducing a few new ones.

DEAD SPACE

The most immediately noticeable difference between the mod and the alpha release is how few zombies there are in the current build. Presumably this limitation is meant to decrease the performance hit caused by populating servers with hundreds of animated corpses, but the low zed count hampers *DayZ*'s moment-to-moment tension and makes looting – a core aspect of the game – feel effortless if you're not bumping into other survivors.

A few adjustments have made the act of looting less monotonous, however. Chernarus's 225km^2 forestscape has been filled out with hundreds of extra searchable buildings, and the interiors of these houses, offices and tower blocks do a better job of hiding canned food and equipment in unexpected nooks. The overhauled inventory system also makes managing your loot a more pleasant task – in particular, I like that clothing items such as pants and shirts have discrete storage slots.

At this point in the game's development, I was hoping that movement and some of the basic actions wouldn't still feel muddled by a combination of clunky input and robotic, uninterruptible animations. Although it has been ameliorated since the early days of the mod, operating context-sensitive objects like doors and ladders still means dancing around to find the sweet spot. And although *DayZ*'s thirst and hunger system has been tweaked, the simple act of eating and drinking is still rigid. I wish I could hold a single key to eat food, rather than scrolling my mouse wheel or right-clicking, selecting 'eat', and waiting for a canned animation to complete so that I can eat some more.

The work Bohemia has done to transform *DayZ* to a functional alpha is significant, though. Rebuilding *Arma 2*'s architecture to reduce the hacking that plagued the mod was a massive task, and *DayZ* as it exists today is better off for the changes made to the inventory, look of the game, and Chernarus itself. But there's still plenty to be done for *DayZ* to shrug its current murder simulation moniker and become the survival game it's supposed to be.

For now, the still-skeletal parts of *DayZ* are worth tolerating in exchange for the stories that await you. If you set out with the goal of having interesting interactions with the other, variously helpful and amoral, people populating *DayZ*'s world, rather than playing it like a combination of *Battlefield 4* and *Diablo*, you'll find a lot to like. ■

Verdict

A story factory, and even with its flaws, one of the better systems-driven sandbox games available.

US$24.99 | PC | WWW.BROKENAGEGAME.COM

Broken Age (Act 1)

Tim Schafer's Kickstarted return to quirky point and click adventuring.

A boy and a girl sit back-to-back in different worlds, neither of them aware of the other's existence, nor that they are linked by an invisible story yet to be told. She is Vella, sitting under a tree stealing a brief moment to herself on the most important – and the last – day of her life. He is Shay, passenger, prince and prisoner of an overprotective spaceship devoted to giving him everything he wants, except the freedom to finally grow up. Today, both face a rite of passage, and afterwards, nothing will ever be the same again.

There's a lot riding on *Broken Age*'s shoulders. It didn't simply have a successful crowd-funding campaign – although raising $3,336,371 to enable *Grim Fandango* creator Tim Schafer to make something new is nothing to be sniffed at. This was the crowd-funding campaign that established that developers really could put fans in charge of their future.

HALF AND HALF

Of the two, Vella's is the more dramatic tale so far. A monster called Mog Chothra regularly descends on an event called the Maiden's Feast to (surprise, surprise) feast on maidens. Weirdly, the maidens can't wait for the opportunity to be eaten and the whole event is treated like a celebration. Even our heroine is more or less OK with it – at least until Mog Chothra turns up and Vella decides to try a new, smarter plan: bail, escape and find a way to kill the damn thing.

Shay's spaceship world is more casual, but also manages to be more unusual. As a character, he's on the verge of clinical depression after a life of being cosseted by a computer mother who won't even let him go out in a spacesuit unless he remembers to put on a scarf. Every day is identical: he's fed the same food and goes on artificial 'missions' designed for toddlers.

Both worlds are relatively small, but gloriously realised, having a hand-drawn look and a surprising variety of sprite animation, costume changes and characters. Schafer and the other writers on board manage to make light, bouncy dialogue and witty banter sound far easier than it actually is.

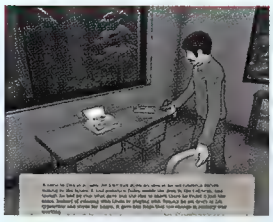
EASY NOW

The best classic adventures constantly found new spins on the genre's formula. So far, *Broken Age* hasn't attempted anything similar, but hopefully the second act has something clever in mind. *Broken Age* might not be close to the length and complexity of previous Tim Schafer games such as *Grim Fandango* and *Full Throttle*, or an instant classic like the *Monkey Island* series, but it's a fine reminder of them. ■

Verdict

A great start for a point-and-click adventure funded by fans of the genre.

★★★★½



The Novelist

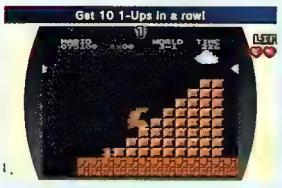
Two wronged makes a writer...

US$15 | PC | THENOVELISTGAME.COM

Dan Kaplan is a writer, struggling to meet his publisher's deadlines for his latest novel. Linda Kaplan is an artist-in-waiting with concerns about the frailty of her marriage to Dan. Their young son Tommy is a regular kid who loves to play and draw but is falling behind on his reading level. And you are a poltergeist who, for three months, has the power to shape the family's future.

A first-person choose-their-own-adventure, *The Novelist* locks you inside a house and asks you to dig into the Kaplans' lives to find out their deepest hopes and dreams. During the day you can read diaries and possess the Kaplans' bodies to uncover what Dan, Linda and Tommy want that week, while at night you can learn about the house's previous occupants by digging through diaries locked inside your own memories.

Play in 'Stealth' mode and you must hide from the Kaplans' eyes by possessing lamps, but that's the extent of the story's game mechanics. Rather, *The Novelist* is all about choice. In any given chapter you can satisfy one family member's needs at the expense of the others', which is why a 'story' option removes all stealth mechanics from the game. How you juggle these decisions determines the fate of the family in what's a fascinating tale about the sacrifices one must make to support others, and a journey so affecting that multiple playthroughs are a must. ■

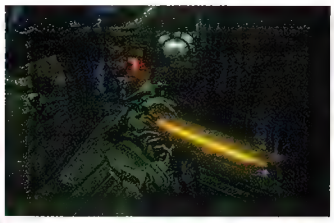


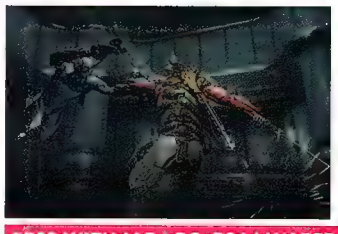
NES Remix

Nintendo school us in old school...

US$15 | WIIU | NESREMIX.NINTENDO.COM/

Remix boils down 16 classic NES games to their core ideas and repackages them as hundreds of WarioWare-ish challenges. *Super Mario Bros* has you crushing tricky goomba formations, for example, while *Donkey Kong* tests hammer skills one second, barrel leaping the next. Nailing goals quickly notches up star ratings, *Angry Birds*-style — with rainbow stars awarded for ludicrously fast runs. While it would be ghastly without the GamePad's crisp button presses, it is interesting to see Nintendo embrace popular iOS thinking. Earning stars in turns unlocks the titular 'remixes', more substantial challenges that radically alter classic games — turning *Super Mario Bros* into an autorunner, pitting Link against *Donkey Kong*'s girders or forcing you to race along a pitch black Excitebike course. These levels are so dappy that we wish they comprised the whole game, but they make for excellent rewards for playing more traditional challenges. The only major downside — apart from seeing how much better Pellett is than the rest of us — is the mix of NES games. Frontloaded with big hitters the game soon makes way for missions set in *Pinball*, *Urban Champion* and Nintendo's sports games. These games aren't deep or varied enough to warrant challenges, making you yearn for major omissions such as *Super Mario Bros 2* and *3*. Or perhaps Nintendo is holding them back for a sequel? Based on the strengths of NES Remix's mostly good bits, we hope to see one soon. ■





FREE WITH IAP | PC, PS4 | WARFRAME.COM

Warframe

Confusing, beautiful and free-to-play.

A four-player co-op shooter built around raids, base defence and occasionally just the sheer joy of killing everything around you, this is the strongest of all the PS4's free-to-play offerings. There's a fascinating world of quasi-mythical sci-fi and unusual art design that creates something genuinely distinct about the Tenno – a band of mystical space warriors – as they battle with the clone-obsessed Grineer.

The setup sees you choosing a Warframe, an almost magical cross between space suit and armour that comes with a range of class-specific benefits and specialities such as electrical attacks, healing, or – in the case of my Mag suit – the ability to affect fields; boosting shields or pulling in enemies with kinetic attacks. As well as the robo-threads, you can also equip and individually level-up guns, pistols and melee weapons. There are also hovering sentinel drones, ability cards to find, equip, fuse and... wow, just so much stuff. That's my main criticism of *Warframe*. I'm enjoying it, yet can't help feel like I'm drowning in content rather than actually navigating it.

With so many options it's baffling – literally – that nothing's explained, leaving you to cautiously nudge around menus like a colour-blind bomb disposal work experience kid prodding wires. A case in point: a wall run that's occasionally vital to proceed. How to do it is never mentioned, and you're never told what the various marks on the walls mean. Rather, you just fortuitously happen to see someone else doing it one day.

Visual issues also crop up from time to time, with the game particularly struggling when things get busy. Physically rendering the action causes the engine constant headaches, while camera troubles and a sheer inability to make sense of all the lights, numbers and effects that can all explode at once in front of you grate – hardly encouraging you to spend actual dosh.

YOU'VE BEEN FRAMED

Two main currencies are at play in *Warframe*: platinum and credits. The former allows you to buy premium things straightaway – be it new suits, weapons and other items – while the latter enables you to purchase blueprints and build them instead. That means you don't have to spend any real money if you're patient enough to grind away. You need to be careful however, as while a blueprint does tell you what combination of space rocks and magic boogers you need to build stuff, it's not clear if you actually have it. As a result, I currently have a gun blueprint, which took me ages to save up for, that I now can't build. Slow claps all round on that front.

Warframe's promise of building a magical space warrior is still worth a look – so long as you embrace the knowledge that you're probably doing it wrong. ■

Verdict

If you can live with the pervading sense of confusion, there's a lot of game here for no money.

★★★½☆

You'll play some big levels, but it's totally linear.

Grab a cup of tea for the many cutscenes.

US$30 | PC | WWW.KONAMI.JP/MGR

Metal Gear Rising

Finally, it's our chance to grab a slice of the action.

Don't know your Shagohod from your La-Li-Lu-Le-Lo? Then a lot of *Metal Gear Rising* won't make sense. It's an action-based spin-off of Konami's brilliant *Metal Gear Solid* stealth series, which has yet to appear on PC beyond ports of the first two entries. Mercifully, familiarity with its convoluted lore isn't necessary to enjoy what is one of the most thrilling, theatrical PC action games.

Rising is the PC debut of Osaka's PlatinumGames, the talented team behind console darlings *Bayonetta*, *Vanquish* and *MadWorld*. It's known for its stylish, deep and absurd fighting games, and it's about time they made one for us. It's not its best – that crown still belongs to lollipop-sucking witch *Bayonetta* – but it's a fine example of a genre sorely underserved on PC.

You play Raiden, a silver-haired cyborg wielding a futuristic samurai sword that cuts metal like butter. He's a whirling, robotic dervish of parries, combos and flurries, all controlled by an elegant combat system. You get two attacks, heavy and light, but you don't have to memorise strings of combos. Instead, the skill lies in parrying.

Push in the direction of an enemy as they strike, hit the light attack button, and Raiden will – depending on how precise your timing is – either block, or parry and hit back with a counter. Like the lightning bolts that appear over thugs' heads in the *Arkham* games, enemies announce attacks with a flash of red light, giving you a cue to prepare your parry.

Nail a counter, or beat up an enemy enough, and you can perform a Zandatsu. I must have done this a few hundred times, and it never gets old. Raiden slices an enemy into ribbons in slow-motion, grabs their spine before they've hit the ground, and absorbs its energy, fully restoring his health. That's the core of the combat. It's fairly basic on paper, but not when you're being piled on by groups of enemies, all with different timings and attacks. This is where the challenge lies – especially fighting the bosses, who are brilliantly over the top. You'll dance across missiles mid-launch while battling a giant robot, slice tanks in half as they're thrown at you, and wrestle with a superhuman US senator. It's totally mental, with that distinct spark of exaggerated personality you only get in Japanese games.

The only thing that dulls Raiden's blade is the camera. It's atrocious, jerking around erratically when you're in the thick of a fight – a real problem when groups of enemies are coming at you from all angles. The world design is also drab, and at odds with the extravagant combat and characters. It looks nice in places, but you have to slog through a lot of sewers and grey warehouses. Those gripes aside, Rising is a welcome sight on PC. Its snappy, responsive combat looks and feels great, and it's wonderfully insane. Can we have *Bayonetta* next, Platinum? ■

Verdict

An effortlessly stylish, elegant fighting game with a very silly sense of humour.

★★★★☆

Might & Magic X: Legacy

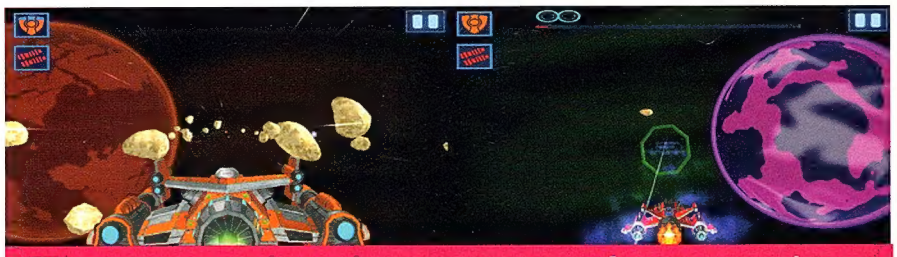
Return to a time of yore – well, 1993.

$39.95 | PC | MIGHT-AND-MAGIC.UBI.COM

Spiritually, *Might & Magic X* can be neatly summed up by its first real conversation, when the captain of the guard at the first town jokes, "Don't worry, I won't send you to go kill rats in a cellar," and then without irony presents a quest called Spiders in the Well. It's a deliberate and careful throwback to the hack-and-slash RPGs of yore, in a style even its own series hasn't done since 1993's *Darkside of Xeen* — the fifth game, and hardly cutting-edge even then.

The action remains turn-based and locked tight to a grid rather than enabling freeform movement, and for the most part, this works oddly well.

However, you get regular reminders of why most games of this style stick to cramped dungeons and forest mazes rather than expansive overworlds, the biggest being that your ranged characters often aren't allowed to take a pop at an enemy standing in front of them because officially they're around a corner. *Legacy*'s actual action is surprisingly pacey. The four-man party primarily levels horizontally, having lots of skills but plenty of points to spread between them which allows for a flexible team. Combat still isn't usually too tactical outside of boss fights, where bad luck can also screw the party over in a hurry, but *Legacy* makes carving through armies feel very satisfying. The result isn't likely to do much for anyone raised on a diet of *The Elder Scrolls*, and even at its best is a nostalgia trip rather than a call for revolution. ■



"The space landscapes you're searching through in the game aren't random asteroid belts but computer-generated representations of scientific data sets, and by hunting through them you're actually part of a massive crowd-sourced attempt to fight breast cancer"

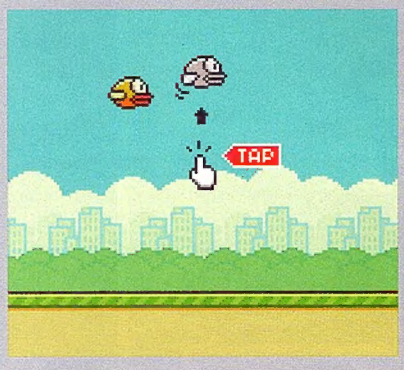
Help science map cancer tumours one spaceship at a time.

Inner Space

Blast some cancer for inner peace.

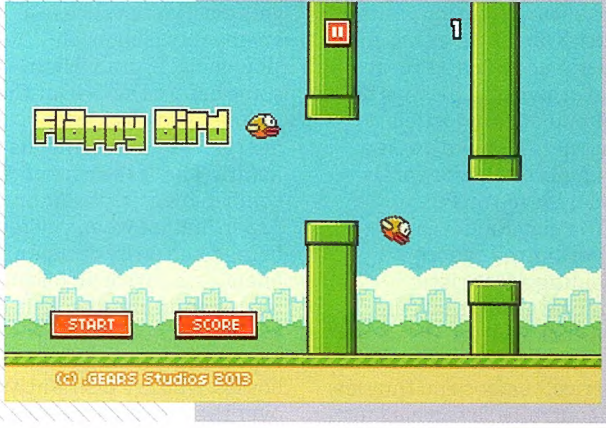
Space shoot'em ups are typically a fairly selfless pursuit, aren't they? After all, it's usually just you on your lonesome, bravely jetting off into deepest darkest space to fight the evil alien horde and save the galaxy from everlasting nastiness. What could be more noble, more righteous than that? Well... how about fighting cancer – for real – at the same time? *Play to Cure: Genes in Space* is one of the most innovative mobile games we've seen in a long time. An initiative of Cancer Research UK, *Play to Cure* charges you as a space trader manoeuvring through asteroid-filled space, hunting for precious energy resources with which you can upgrade your ship, weapons and equipment.

Yep, the scenario might sound like it's ripped out of a zillion or so other space shooters, but what sets *Play to Cure* apart is the action going on behind the scenes: the space landscapes you're searching through in the game aren't random asteroid belts but computer-generated representations of scientific data sets, and by hunting through them you're actually part of a massive crowd-sourced attempt to fight breast cancer. The way players steer their ships through the game actually gives researchers valuable human-based feedback on the makeup of real breast tumour data. As *Play to Cure's* developers put it, "Instead of one lone scientist analysing a cancer data set by eye for hours, a group of gamers can get through that data simply by playing [the game]." Sounds like sci-fi? That's because it is... and isn't. Check out *Play to Cure: Genes in Space*, free for iOS and Android, and fight the good fight.



How to get rich: *Flappy Bird* edition

Speaking of gaming innovation... actually there's no way we can finish that intro sentence meaningfully given this story is about *Flappy Bird*. If you haven't heard of it, it was the mobile game of the moment in early 2014, hogging the #1 spot on both the App Store and Google Play, where it happily (flappily?) flew high for weeks... until its Vietnamese developer, Dong Nguyen, pulled it from sale, citing the media glare was too intrusive and the game's meteoric success meant it was too "addictive". By that point, the free game had been downloaded millions upon millions of times – much to the puzzlement of the gaming industry, as *Flappy Bird* redefines 'unremarkable'. Unremarkable graphics, unremarkable gameplay, zero story... In fact, there's essentially nothing noteworthy about the game at all, aside from its bizarre 15 minutes of fame. But just because it was free didn't mean Nguyen was simply giving the game away. Far from it: *Flappy Bird* is ad-supported, and the through-the-roof viral success the game enjoyed meant it was serving up *a lot* of ads. How many? Well, we don't know the exact number, but in an interview Nguyen disclosed he was earning on average US$50,000 per day. Not bad money for a game he developed in his spare time, no? ■



Flappy Bird's creator is up in a flap, despite the game's success.

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